

Arm. (2nd) Plates 1-8

E. Ellis & Ford.

P. R. Cooper.

Parts 1 to 6.

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ILLUSTRATIONS OF DISSECTIONS.

DESCRIPTION OF THE PLATES.

DESCRIPTION OF PLATE I.

THE superficial muscles of the thorax, and the axilla with its contents, are delineated in this Plate. The natural size of the dissected part has been slightly reduced in the Drawing for the purpose of showing the whole of the upper limb.

In the preparation of the dissection the limb was drawn away from the trunk to render tense the muscles. Next, the integuments were divided, and the skin and fat were raised together in one large flap from the front of the thorax and the axilla by carrying the scalpel upwards and outwards from the chest to the arm, as the fibres of the muscle run, and along one muscular fasciculus at a time. Afterwards the fat was cleared out of the axilla; and the muscles bounding the space behind were laid bare in the same way as those limiting it in front.

MUSCLES OF THE THORAX AND ARM.

Two sets of muscles are displayed in the dissection; one bounding the arm-pit before and behind; and the other lying in front, and at the back of the humerus.

The former group are directed from the trunk to the limb, and move the limb forwards and backwards over the chest. Where they are fixed to the thorax they are separated widely by the ribs, but

at the arm bone they approach one another. In the interval between them, near the humerus, the large vessels and nerves of the limb are lodged.

The muscles of the arm connect the limb with the scapula, and assist in the movements of the shoulder joint: they will be more fully seen in other Plates.

A. Pectoralis major.	K. Coraco-brachialis.
B. Pectoralis minor.	L. Biceps.
C. Latissimus dorsi.	M. Fascia of the arm.
D. Teres major.	N. Triceps muscle.
F. Serratus magnus.	P. External head of the triceps.
H. Subscapularis.	

The *pectoralis major*, A, reaches from the chest to the arm over the front of the axilla. By its inner end (origin) it is attached to the sternum and the cartilages of the true ribs, except the last, as well as to a part of the clavicle; and it joins the tendon of the external oblique muscle of the abdomen below. By its outer end (insertion) it is fixed into the bicipital groove of the humerus. Plate ii. P.

The muscle forms the main part of the anterior boundary of the axilla; and towards its lower end near the arm-pit the mamma or breast rests on it.

Should the breast be diseased so as to render necessary its removal, the limb should be placed during the operation in the position shown in the Illustration, and the scalpel should be carried in the direction of the fibres in detaching the mass to be extirpated.

The *pectoralis minor*, B, is extended, like the preceding, from the chest to the limb in front of the axilla. Only a very small part is now visible: for a view of the muscle see Plate ii. B.

The *latissimus dorsi*, C, resembles in its position behind the axilla the large pectoral muscle in front. Arising below from the spinal column, the pelvis, and the lower ribs, it is inserted into the bicipital groove of the humerus. The upper edge of the muscle has been everted in the Drawing to bring into sight the vessels and the nerve lying inside it.

Oftentimes a fleshy slip is continued from the latissimus over

the axillary vessels to join the pectoralis major, the fascia of the arm, or the coraco-brachialis muscle.

The *teres major*, D, lies behind the latissimus, by which it is partly concealed. Attached below to the scapula, it is inserted into the humerus beneath the broad muscle of the back, C.

The three muscles, pectoralis major, latissimus, and teres, converging from the trunk and scapula to the upper part of the arm-bone, will approximate the raised moveable limb to the trunk when they act simultaneously; and the limb will be moved forwards or backwards in accordance with the preponderating power of the pectoral or of the two others. Their action may occasion dislocation of the humerus under the following circumstances. In falling, with the arm outstretched, the elbow comes into contact with the ground, and renders the lower end of the humerus immoveable; and if the muscles then act suddenly and forcibly they will draw down the upper end of the bone, which is free to move, and bring it into the axilla.

The *serratus magnus*, F, shuts out the ribs from the axilla, as it is directed backwards from the chest to the scapula. Its separate slips of origin from the ribs (serrations) are marked by the passage between them of nerves, and here and there of small vessels.

The *subscapularis*, H, fills the hollow of the scapula and excludes this bone from the axilla. The upward and outward direction of its fibres over the shoulder joint is indicated in the Figure. For a description of the muscle, see the explanation of Plate ii.

The *arm muscles* are the coraco-brachialis, K, and biceps, L, in front of the humerus, and the triceps, N, behind that bone. The share taken by the two last muscles in the outline of the limb may be seen in the Drawing: their anatomy will be studied in other dissections.

The *coraco-brachialis*, K, attached as the name expresses, is displayed fully in Plate ii. As here seen, it is partly subcutaneous, and lies partly beneath the pectoralis major. The swell of the muscle is felt readily through the teguments, and serves as the surgeon's guide to the axillary artery along its inner edge.

BOUNDARIES OF THE AXILLA.

The axilla corresponds with the surface depression of the arm-pit. As it is a portion of the space included by the thoracic muscles converging to the humerus, it has necessarily a pyramidal form; and it is limited in front and behind chiefly by those muscles, whilst inside it is the chest, and on the outside the humerus. This intermuscular interval lodges the large vessels and nerves of the limb, with lymphatics, and contains a loose granular fat.

Along the fore part lies the pectoralis major, A, reaching from apex to base, and forming by its lower or free edge the anterior fold of the arm-pit; and underneath it, constructing only a small part of this boundary, is the pectoralis minor, B. After the fat had been removed from the space, the pectoralis sank down somewhat, as the Drawing indicates, in consequence of the body not being very fresh.

Bounding the interval behind are three muscles, viz., the subscapularis, H, the latissimus, C, and the teres major, D: the two latter muscles enter into the formation of the lower part of this boundary, and extend lower down the limb than the pectoralis. Within the edge of the latissimus, here shown everted, is a hollow containing vessels, nerves, and glands, in which pus may burrow, or slightly enlarged glands may lie undetected by the fingers.

On the inner convex side of the axilla is the serratus magnus, F, covering the four highest ribs and their intercostal muscles.

On the outer side, where the space is limited, are placed the humerus and the contiguous part of the scapula, with the coracobrachialis, K, and biceps, L, muscles.

The base, or the elongated lower opening of the axilla, is wider at the chest than at the arm; but it is not so wide before as after the dissection, because the parts when cleaned separate from each other. A rather dense fascia closes the axillary space in this direction, and impedes the advance of pus to the surface.

The apex or narrowed part of the space joins the root of the

neck, and lies between the chest and the scapular arch. It cannot be recognised in this Figure, but it may be observed more completely in Plate ii.

The state of the muscular boundaries of the axilla is much altered by the position of the limb; for the tenseness is diminished when the arm is adducted, and increased when the arm is abducted from the thorax. And the depth will vary, in like manner, with change in the position of the limb. These facts may be remembered with advantage in any endeavour to estimate the size of a tumour in the axilla.

In consequence of the position of this intermuscular space at the inner side of the shoulder bone, and of the loose nature of the fatty tissue contained in it, the movements of the scapula over the chest are facilitated. And from its situation on that side of the shoulder joint to which flexion is made, the large vessels and nerves of the limb are transmitted through it beyond the joint without injury from stretching in the motions of that articulation. A corresponding hollow exists in the lower limb in front of the hip-joint.

In the undissected limb the student may recognise by the eye and the touch the prominence of the cords of the large axillary nerves and vessels along the side of the arm; and if the arm is raised and freely moved by one hand, whilst the two fore fingers of the other are pressed into the arm-pit, the moving head of the humerus may be felt through the skin and fascia. During life the hollow is useful to the surgeon in his attempts to discover the nature and size of an enlargement, such as an aneurism, in this situation, or the position of the dislocated head of the humerus. But the size of the space interferes with the detection of small tumours, like an enlarged gland; for these may extend upwards and inwards towards the chest in the loose fat, and acquire considerable size before their presence will be indicated by any external swelling.

ARTERIES OF THE AXILLA.

The lower end of the axillary artery with its branches are now brought under notice ; but only a small narrow strip of the arterial trunk can be seen in the Figure in consequence of its connections with veins and nerves being preserved. This part of the vessel is uncovered by muscle, and is in contact with the common investing parts of the limb. A superficial wound of the limb may lay it open. It supplies branches to the chest and the shoulder.

<i>a.</i> Axillary artery.	<i>h.</i> Posterior circumflex.
<i>b.</i> Long thoracic.	<i>n.</i> Cutaneous artery with the internal cutaneous of the musculo-spiral nerve.
<i>d.</i> Alar thoracic.	<i>o.</i> Artery to the long head of the triceps muscle.
<i>e.</i> External mammary.	
<i>f.</i> Subscapular.	
<i>g.</i> Dorsal scapular.	

The *axillary* or main artery of the upper limb crosses the space from the chest to the arm beneath the pectoral muscles, but only the part between the lower border of the pectoralis major, A, and the lower border of the teres major, D, is delineated. Its position is marked by the swell of the coraco-brachialis muscle, K ; and its depth from the surface is very slight, only the tegumentary coverings of the limb concealing it, so that it can be readily reached in an operation, or it can be compressed with ease against the humerus.

Its connections with the muscles around are the following :— Behind are the subscapularis, H, the latissimus, C, and teres major, D ; and on the outer side is the coraco-brachialis, K.

Its companion vein (axillary) is placed on the inner or chest side, partly concealing the artery, and has to be drawn aside in attempts to tie the arterial trunk.

Large nervous cords lie around the artery :—outside is the median nerve, 22 ; inside the ulnar, 21, and the nerve of Wrisberg, 11 (which is sometimes nearer the artery). Superficial to the vessel is the large internal cutaneous, 18 ; and deeper than it or beneath, is the musculo-spiral, 13 (which is drawn somewhat

inwards below); another nerve beneath the artery for a short distance is the circumflex, 12.

Two named branches, the subscapular, *f*, and the posterior circumflex, *h*, leave this part of the artery opposite the edge of the subscapularis muscle.

Ligature of the vessel. The origin of several branches from the axillary artery opposite the shoulder joint, would interfere with the application of a ligature at that spot; but for a distance of two inches beyond (towards the arm) the vessel is free from any large branch, and might be tied without risk of hæmorrhage.

Suitable as the lower part of the axillary trunk seems to be for an operation at this place, surgeons have not chosen it for the application of a ligature. Doubtless the advantages offered by tying the brachial and subclavian arteries have caused those vessels to be selected in preference to the axillary; but the small channels that remain for the collateral circulation after the main artery is secured may have had some influence in inducing surgeons to let the operation on this part of the axillary artery remain unpractised. For the only collateral vessels to carry on the circulation after the occlusion of the trunk would be the small and indirect anastomoses through the following muscles, viz., the coraco-brachialis, biceps, and long head of the triceps; and through the shaft of the humerus.

Although the collateral vessels are so small and indirect, they are sufficient for carrying on the circulation, as the artery has been tied with success in this situation. M. Blandin secured the vessel here in a man who received an injury of the artery from the discharge of a gun. The man recovered.*

Should the surgeon be called upon to tie the artery he should keep in mind its situation along the edge of the coraco-brachialis, with its companion vein on the thoracic side and partly concealing it, and with large nerves of the brachial plexus around it. Though the vessel is usually very superficial, it may be placed under muscular fibres directed over it from the latissimus to the pectoralis.

* *Traité d'Anatomie topographique*, p. 506 : Paris, 1834.

collat. circ.
after lig of
3^d part artery

Two other points deserve attention also : Firstly, that two arteries instead of one may be found as often as 1 in 10.* Secondly, that not unfrequently the nerves, which should serve as the deep guide to the artery, are not placed around the parent trunk, but encircle a large branch formed by the conjunction of the usual offsets at this spot with some of the branches which are derived, as a rule, from the brachial artery.

When practising on the dead body the tying of the part of the artery issuing from the axilla the following directions may be observed :—

The limb is to be placed at right angles to the trunk, and the operator stands between the two.

With the eye fixed on the prominence of the coraco-brachialis muscle, K, which is the superficial guide to the vessel, a cut is to be begun in the hollow of the arm-pit, and to be continued along the side of the muscle for two inches ; but the knife is not to be carried deeper at first than through the skin and fat.

The axillary vein will now be recognised through the deep fascia or aponeurosis of the limb by its blue colour ; and the aponeurosis being divided along the outer edge of the vein as far as the cut in the integuments, this vessel may be detached with care from the subjacent parts, and drawn inwards with a narrow retractor.

Next, the brachial plexus around the artery will serve as the deep guide. Search is to be made for the axillary trunk by cutting a piece of fat from the hollow out of which the vein has been drawn ; and it is to be made in a horizontal direction or towards the humerus, instead of backwards towards the axillary fold. The operator tries to find the artery in the midst of the nerve-trunks without attempting to distinguish the individual nerves.

After the thin arterial sheath has been opened by the knife, the needle may be passed readily, and the vessel is to be tied with as little displacement as possible.

When the artery is not surrounded by the nerves of the brachial

* The facts on which this statement rests will be found in the *Surgical Anatomy of the Arteries of the Human Body*, by Richard Quain, F.R.S. : London, 1844.

plexus, as referred to above, it will be nearer the vein and the surface than it is usually.

In the treatment of aneurism of the lower end of the axillary trunk Professor Syme has recently recommended a return to the old practice of opening the sac, and after removing the contents, putting a thread around the vessel above and below the sac. In a postscript to a communication published in the *Medico-Chirurgical Transactions** he says :—"On the 15th of August, in accordance with the principles above explained, I performed the old operation for aneurism, not traumatic, at the lower part of the axilla, in a gentleman about fifty, recommended to my care by Dr. Embleton, of Embleton in Northumberland. The patient returned home on the 5th of September."

Branches of the artery. The lower part of the axillary artery supplies the following branches to the wall of the chest and the shoulder.

Long thoracic artery, b, lies in the axilla along the angle formed by the meeting of the anterior and inner boundaries, and may be injured by a cut made along the anterior axillary fold. Its origin is concealed by the pectoralis major.

Alar thoracic branch, d. This small artery to the arm-pit was present in this body, though it is generally absent (Quain). It is distributed to some of the glands, and to the fat of the axilla.

The *subscapular artery, f*, is the largest offset, and arises opposite the edge of the subscapularis muscle. Taking the border of the muscle as its guide, it reaches the chest, to which and the shoulder it is distributed. A companion vein and nerve run with it, and all are secured from external injury by the projecting margin of the latissimus dorsi. Many offsets enter glands and the contiguous muscles ; and one, *g*, larger than the rest, is the dorsal scapular artery.

The *posterior circumflex artery, h*, arises close beyond the preceding, and winds behind the humerus to the shoulder with the nerve, 12, of the same name. Its distribution is represented in Plate v.

* On the Treatment of Axillary Aneurism, by James Syme, F.R.S. Edin., vol. 43, p. 143 : London, 1860.

An *anterior circumflex artery*, not now visible, crosses between the humerus and the coraco-brachialis to the shoulder.

The *external mammary, e*, is a long slender irregular branch, which is directed across the axilla to the chest, lying about midway between the anterior and posterior folds. It supplies the glands, and the wall of the chest, assisting the long thoracic artery.

Muscular and cutaneous branches.—Small offsets near the end of the artery supply the coraco-brachialis, K, and the long head of the triceps, N. And a cutaneous twig, *n*, accompanies the internal cutaneous branch of the musculo-spiral nerve.

An inspection of the Drawing will suffice for showing the vessels or nerves likely to be injured in wounds into the axilla, or in incisions made into it by the surgeon. Along the anterior boundary, where this joins the chest, are placed the long thoracic vessels; and lying along the posterior boundary, but within the margin of the latissimus, are the subscapular vessels and nerves with glands. On the side of the limb, or at the outer part, the trunks of the axillary vessels and nerves, and the cords of the brachial plexus are aggregated together; whilst on the side of the chest there is only an occasional small artery. If an incision is to be made into the arm-pit the surgeon should select the inner boundary as the freest from vessels, and should direct the knife about midway between the anterior and posterior folds.

VEINS OF THE AXILLA.

Only the position of the chief vein to the artery was retained in the dissection; and the smaller veins, which would complicate the drawing without corresponding utility, were removed.

l. Axillary vein.
m. Subscapular vein.

p. External mammary vein.
r. Cutaneous and muscular vein.

The *axillary vein, l*, the chief trunk of the limb, is continuous in the arm, just beyond the axilla, with the cutaneous vein—basilic. Placed on the inner or thoracic side of, and partly concealing the axillary artery, it receives small contributing veins corresponding with the arterial branches. Some of these are seen in the Plate.

Frequently two veins instead of one are present in the lower part of the axillary space.

Through this vein nearly the whole of the blood of the limb below the shoulder is conveyed onwards; and interruption to its current will occasion congestion in the parts to which its roots extend. A tolerably complete occlusion of this main circulating channel, as in the case of a slowly-growing tumour, will not only give rise to congestion, but will cause serous fluid to transude through the coats of the vessels into the surrounding textures.

NERVES OF THE AXILLA.

The nerves in this dissection are derived from two sources:— Those on the side of the chest are offsets of the intercostal nerves, and appear between the digitations of the serratus magnus muscle; and those lying around or near the axillary vessels belong to the brachial plexus.

LATERAL CUTANEOUS OF THE THORAX.

1. Lateral cutaneous branch of the second intercostal nerve (the highest of the set).
2. Offset of third intercostal.
3. Offset of fourth intercostal.
4. Offset of fifth intercostal.
5. Offset of sixth intercostal.
6. Anterior branch of the offset of the second intercostal.
- *** Anterior branches of the offsets of the other intercostal nerves.
7. Communicating branch to the nerve of Wrisberg from the offset of the second intercostal nerve. = *intercosto-hum.*

BRACHIAL PLEXUS.

8. Nerve to the teres muscle. (*lower Subscap.*)
9. Subscapular nerve. (*= middle or long subsc.*)
10. Nerve to the serratus magnus. (*Post. Thorac.*)
11. Nerve of Wrisberg.
12. Circumflex nerve.
13. Musculo-spiral.
14. Offset of the musculo-spiral to the triceps.
16. Internal cutaneous of the musculo-spiral.
18. Large internal cutaneous.
20. Offset of the internal cutaneous to the integuments.
21. Ulnar nerve.
22. Median nerve.

NERVES OF THE BRACHIAL PLEXUS.

The *median*, 22, is the companion nerve to the axillary artery, and is placed on the outer side.

The *ulnar nerve*, 21, smaller than the median, but without branch like it, lies to the inner side of the arterial trunk.

The *musculo-spiral*, 13, occupies, naturally, a position beneath the vessel, but it has been pulled inwards, and is represented in the Plate as on the inner side. Here it furnishes two small branches : one muscular, 14, to the inner and middle heads of the triceps ; the other is the internal cutaneous, 16, which is distributed to the integuments of the back of the arm.

The *circumflex nerve*, 12, accompanies the artery of the same name, *h*, to the deltoid muscle. See Plate v.

Large internal cutaneous nerve, 18, lies on the axillary artery, and gives a small cutaneous offset, 20, to the integuments of the arm over the situation of the bloodvessels ; but its direction has been altered by the displacement of the skin.

Small internal cutaneous nerve, 11, (nerve of Wrisberg) issues beneath, though sometimes through the axillary vein, and is joined by a branch, 7, from the highest lateral cutaneous nerve of the thorax. Its position close to the vein has been disturbed by the dragging of the skin.

Muscular branches. The nerve to the *teres major*, 8, and the nerve to the *latissimus*, 9, are directed with the subscapular vessels along the back of the arm-pit to their destination ; the former gives an offset to the subscapularis muscle.

The nerve to the *serratus magnus* is continued on the surface nearly to the lower border of its muscle, giving backwards offsets to the fleshy fibres. Its origin is connected with the trunks of the fifth and sixth cervical nerves in the neck.

Pressure applied to the nerves of the brachial plexus may occasion pain, or loss of power and feeling, according to its degree, in a greater or smaller part of the limb. In the use of crutches the weight of the body acts injuriously on the nerves, for the arm is arched over the top of the crutch, and the nerves are compressed between the humerus and the artificial prop of the body. This inconvenience may be remedied by the crutch-head being so constructed as to bear least on the centre of the arm over the large nerves.

LATERAL CUTANEOUS NERVES OF THE THORAX.

Five *lateral cutaneous branches* of the intercostal trunks were laid bare in the dissection; they appear lax after they have been separated from the surrounding fat. The branches directed forwards over the pectoralis were necessarily detached from the skin, and were then laid on the surface of the muscle.

As the first intercostal trunk does not furnish commonly any lateral cutaneous branch, the nerves shown are derived from the five next intercostal trunks. Each branch divides into two parts (anterior and posterior) as it issues between the ribs, and these terminate on the lateral part of the thorax.

The anterior offsets, 6, * * *, end in the integuments covering the pectoralis major; and the posterior, 1, 2, 3, 4, 5, somewhat larger in size, ramify in the skin of the arm, and in that over the latissimus dorsi. In this body the third nerve wanted an anterior offset.

The highest and largest of the lateral cutaneous nerves,—that from the second intercostal trunk, differs in some respects from the others. Its anterior branch, 6 (laid on the pectoralis, and not always present), supplies the arm-pit as well as the teguments on the pectoralis major: its posterior branch, 1, called intercosto-humeral, reaches the integuments of the back of the arm, and gives a communicating offset, 7, to the nerve of Wrisberg.

LYMPHATICS OF THE AXILLA.

Only a few of the glands of the axilla were retained in the dissection, and these have fallen, necessarily, from their natural position after the removal of the fat in which they are imbedded.

† † † Anterior group of the axillary glands.

s s s. Posterior group of glands.

t. One of the group of glands along the side of the axillary vessels.

About ten or twelve in number, the glands vary much in their shape and size. They have the following general linear arrangement in sets. The greater or hinder group lies along the sub-

scapular vessels within the edge of the latissimus dorsi; but after the dissection of the axilla they hang in front of the muscle by their small vessels, as is shown in the Plate. Another or anterior group is nearer the fore part of the axilla, in connection with the long thoracic and external mammary arteries. And a third set is placed along the large axillary vessels.

Each collection of glands has for the most part its own set of lymphatic vessels. Thus the anterior group receives lymphatics from the fore part of the thorax and from the mamma: the posterior group is joined by the lymphatics from the side of the chest, and from the back; and that along the bloodvessels transmits lymphatics from the upper limb. The lymphatic vessels, after passing through their respective glands, unite into one or more trunks at the top of the axilla, and open into the lymphatic duct of the same side.

Disease in the part from which the lymphatic vessels are derived may occasion enlargement of the group of glands through which those vessels are transmitted; and the knowledge of the destination of the lymphatics will suggest the glandular group likely to be affected:—Thus, a poisoned wound of the hand, as in dissection, will cause inflammation of the glands by the side of the axillary vessels; and so forth.

In making the necessary examination to detect disease of the glands, the limb should be approximated to the side to relax the muscles and fascia bounding the axilla, and thus to permit easier and freer manipulation. The glands near the axillary vessels follow the arm when this is elevated.

Enlargement of a gland may surround or press upon the intercosto-humeral nerve, or the nerve of Wrisberg, and occasion numbness in the part to which either nerve is distributed.

Should extirpation of a diseased gland be considered advisable, the surgeon should be mindful that it has large bloodvessels, in the form of a foot-stalk, which are derived from the contiguous vessels; and he should secure the vascular pedicle with a thread before he cuts it through. If this precaution is neglected the divided vessels retract into the loose areolar tissue of the axilla, and may continue to bleed at intervals so as to endanger life.

FAT IN THE AXILLA.

The axilla is filled with a granular fat intermixed with slight areolar tissue. Towards the apex of the space the adipose tissue diminishes. In thin bodies the quantity of the fat is less, as it is in all other parts, and the space contains a watery fluid in the meshes of the areolar tissue.

The presence of fat favours in this space, as elsewhere, the accumulation of pus, which burrows amongst the loose fatty material instead of making its way to the surface through the intervening fascia. Much inconvenience and suffering may be avoided by an early incision for the escape of the confined pus.

DESCRIPTION OF PLATE II.

THE Figure represents the deep dissection of the front of the chest, and that of the axillary vessels and the brachial plexus of nerves with their branches.

The dissection is to be made by cutting through and reflecting the pectoralis major. To render tense and distinct the sheath of the axillary vessels, place the limb at right angles to the trunk, and rotating it inwards, press it backwards, so as to raise the clavicle from the chest. Unless this position of the arm is kept, the loose costo-coracoid sheath may be removed with the fat.

SUPERFICIAL PROMINENCES OF BONE.

At the upper part of the region dissected is the bony loop of the scapular arch, which is formed by the clavicle, J, and the scapula, and separates the neck from the chest and the limb. It serves the purpose of articulating the upper limb, and furnishes points of attachment to muscles moving the humerus. Injury of the arch, sufficient to break it, will arrest the free movements of the shoulder joint, and interfere with the action of the muscles.

Part of the arch is subcutaneous, and the fore finger when carried along it traces successively the outline of the clavicle, acromion, and spine of the scapula. From its slight depth injuries of it are easily ascertained, because all irregularity of the surface can be detected at once with the finger.

On the inner side of the shoulder joint below the clavicle, and projecting at the edge of the deltoid muscle, R, is the coracoid process. It gives attachment to the three muscles B, K, and L, as well as to a strong ligament (coraco-clavicular), which passes from its upper and hinder part to the under surface of the clavicle, and unites together firmly the two bones. On the surface of the body this projecting osseous point can be felt between the deltoid and pectoral muscles.

In consequence of the clavicle acting as a prop to keep the shoulder from the trunk, it is very liable to be broken. By direct violence it may be shattered at any spot; but force applied to the outer end through a fall or a blow produces fracture generally about the middle of the bone.

In fracture of the shaft, that is, internal to the line of the coracoid process and the strong ligament joining this part to the clavicle, the scapula and shoulder joint, having lost their support, fall downwards and inwards towards the chest, forcing the outer past the inner fragment; and the large muscles of the chest which are inserted into the humerus assist in bringing the shoulder into closer apposition with the thorax. The inner fragment, freed from the weight of the shoulder, remains in its natural position, though it appears more than usually prominent; and the muscles attached on opposite sides, viz., the great pectoral and sterno-mastoid, may act also as antagonists, and prevent its displacement.

If the fracture takes place opposite the strong ligament uniting the coracoid process with the clavicle, the scapula remains attached to the clavicle by that ligament, though not perfectly supported by it, and the shoulder falls but little towards the chest.

In fracture external to the ligament, there is, however, considerable displacement of the bone, for the outer detached end being loose, and being acted on by the trapezius muscle, is placed in

front of, and may take even a position at a right angle to the other.*

In replacing the external fragment of a broken shaft of the clavicle, the piece of bone must be moved outwards indirectly by forcing outwards the scapula; and it is to be raised to the level of the inner fragment by lifting and supporting the elbow.

At the outer part of the dissection is the projection of the shoulder, which is produced by the upper end of the arm bone covered by the deltoid muscle, R. When the limb is pendent the swell of the muscle runs into that of the arch formed by the clavicle and acromion; and when the limb is raised and lowered, the arm bone can be felt moving under the muscle.

In dislocation of the shoulder joint the upper end of the humerus sinks down from the deltoid; and a hollow then occupies the site of the prominence. This injury is accompanied necessarily by unnatural direction of the shaft of the arm bone forwards or backwards, and by a sharp edge along the bony arch of the clavicle and the acromion process.

MUSCLES OF THE THORAX AND ARM.

A. Pectoralis major.	K. Coraco-brachialis.
B. Pectoralis minor.	L. Biceps, its short head.
C. Latissimus dorsi.	O. Biceps, the long head.
D. Teres major.	N. Triceps extensor brachii.
F. Serratus magnus.	P. Insertion of pectoralis major.
H. Subscapularis.	R. Deltoid muscle.
J. Clavicle with the cut attachment of the pectoralis major.	S. Subclavius muscle.
	V. Costo-coracoid membrane.

The muscles of the chest and shoulder, which are partly displayed in the Drawing, give to the scapula and the shoulder joint some of their varied movements.

The scapula has a gliding motion over the ribs, and can be moved in opposite directions. It is drawn forwards by the small pectoral, B, and serratus magnus muscle, F, which attach it to the chest.

The shoulder being a ball and socket joint is provided with

* A Treatise on Fractures in the Vicinity of Joints, by Robert William Smith, M.D.: Dublin, 1850; p. 210.

muscles on opposite sides; but only two are now evident, viz., the deltoid or great abductor, R, and the subscapularis or internal rotator, H.

In the group of thoracic muscles are included the pectoralis major and minor, the serratus magnus, the latissimus dorsi, and the subclavius.

Pectoralis major, A. After the division of the muscle the parts underneath it can be observed. It covers the pectoralis minor on the chest, and the coraco-brachialis, K, and the biceps, L and O, in the arm. Near the clavicle the subclavius muscle, S, and the costo-coracoid membrane, V, lie beneath it. Above and below the pectoralis minor the axillary vessels and nerves are covered by the great pectoral muscle alone.

At its insertion the tendon is divided into two parts, with an interval between, something like a sling. On the under piece, P, the lower chest fibres are received; and in the other (seen only in part), the upper thoracic and the clavicular fibres terminate.

The *pectoralis minor*, B, is attached to the side of the chest, and to the third, fourth, and fifth ribs; it is inserted externally into the coracoid process of the scapula, where it blends in a common tendon with the coraco-brachialis, K, and the short head of the biceps, L.

Between the chest and the shoulder the muscle forms part of the anterior boundary of the axilla, and lies over the axillary vessels and nerves; and between the muscle and the clavicle is a triangular interval—the sides being formed by that bone and the pectoralis minor, the base by the thorax, and the apex by the coracoid process—in which the upper part of the axillary artery may be tied. Its position to other vessels and nerves is so apparent as not to need farther notice.

The pectoralis minor assists the serratus, as before said, in drawing forwards the scapula; and it may act as a muscle of forced inspiration when the scapula is the fixed part.

Serratus magnus, F, covers the side of the chest, taking origin by nine fleshy slips from the eight upper ribs; and it is inserted into the base of the scapula. Its special nerve, 5, lies on the surface, and distributes offsets to it.

From the direction of its fibres the muscle is chiefly employed in moving forwards the scapula over the ribs; and, when the scapula is fixed, it will act on the ribs so as to draw them outwards, and increase the size of the chest in inspiration. It supports, too, the lower end of the scapula whilst a weight is carried on the shoulder.

Latissimus dorsi, C. The oblique direction of this muscle behind the axilla, converging with the pectoralis major to the insertion into the humerus, is more fully seen in this than in the preceding dissection. The chief notice of this muscle is given with the explanation of Plate i.

Subclavius, S. This small muscle is contained in a sheath of the costo-coracoid membrane, of which a piece has been cut away near the inner end. Named from the position to the clavicle, its origin is attached to the first rib, and its insertion is fixed into the grooved under surface of the clavicle.

It can depress the clavicle or elevate the first rib, according as the one or the other bone may be in a state to be moved.

The shoulder muscles coming into view in this dissection are, the subscapularis, teres major, and deltoid.

The *subscapularis*, H, arises from the hollowed costal surface of the scapula; and its fibres are directed outwards and upwards over the shoulder joint to their insertion into the small tuberosity and the neck of the humerus.

By its lower edge it projects much beyond the scapula, and touches the latissimus dorsi and teres major. The subscapularis supports internally the shoulder joint, of which it is one of the articular muscles.

When the arm is raised, the subscapularis assists in depressing it; and the hanging limb is rotated inwards by the muscle.

This muscle is injured in the following dislocations of the humerus. When the bone is forced into the lower part of the axilla, it may either be covered by the subscapularis; or may be driven through the muscular fibres, and, coming into contact with, press upon the mass of the axillary vessels and nerves. In the forward dislocation on the inner side of the cervix of the scapula, the head of the bone passes between the subscapularis

and the scapula, separating the fleshy fibres from the blade-bone, and projects above the upper border of the muscle.*

Teres major, D. Only the general position of the teres, which extends from the lower angle and border of the scapula to the humerus, can be now seen. The muscle is described with Plate v., D.

The *deltoid muscle*, R, forms the prominence of the shoulder, and reaches from the scapular arch to the arm bone below the level of the axilla. Only the fore part of the muscle is here represented: its insertion and connections are seen in Plate v., N.

Three muscles of the arm, biceps, coraco-brachialis, and triceps, are laid bare in the dissection—the two former, which are superficial to the humerus, being much more apparent than the latter, which is behind the bone. The anatomy of the triceps will be given in the notice of Plate vi.

The *biceps* muscle consists above (origin) of two parts, long head and short head.

The short head, L, is fixed by a wide tendon to the coracoid process; and the long tendinous head, O, narrow and rounded, passes along the groove in the humerus, and through the shoulder joint, to be attached to the top of the glenoid articular surface of the scapula.

The muscle is shown lower in the arm in Plate iv.

Coraco-brachialis, K. It arises from the coracoid process of the scapula, and the tendon of the short head of the biceps; and it is inserted into the inner side of the shaft of the humerus about midway between the ends. Its upper extremity lies beneath the pectoralis major; its insertion is concealed by the brachial vessels; and the intermediate part (belly) is subcutaneous in the arm-pit, and serves as the guide to the axillary vessels. Through the fleshy fibres of the muscle the musculo-cutaneous nerve, 11, is transmitted.

* The student will find the state of the muscles in dislocations of the shoulder joint fully treated in the article, Abnormal Conditions of the Shoulder Joint, in the *Cyclopædia of Anatomy and Physiology*, by Robert Adams, Esq., 1849.

If the limb is in a state of abduction, it can be brought to the side of the chest by this muscle.

The *costo-coracoid* membrane, V, is a rather strong layer of fascia between the upper limb and the neck, and is placed there apparently for the purpose of protecting the large blood-vessels. Occupying the interval between the first rib and the coracoid process, it is fixed above to the clavicle before and behind the subclavius muscle which it incases. Below it blends with the special sheath (axillary) of the blood-vessels, giving to this additional strength; and it is continued onwards beneath the small pectoral muscle, where it gradually ceases.

The *axillary sheath* around the vessels and nerves coming from the neck to the upper limb, consists in part of a prolongation from the deep fascia of the neck, and in part of a stronger layer added from the costo-coracoid membrane. It resembles the crural sheath around the blood-vessels of the lower limb, and is funnel-shaped like that tube. In it are the axillary artery and vein, and the brachial plexus; and piercing the front are branches of those trunks, viz., the cephalic vein, *l*., the acromial thoracic artery, *c*., and anterior thoracic nerves, 2, 3. In a dissection of the axillary sheath the tube is to be opened in the manner shown in the drawing, to see the position to each other of the contained blood-vessels and the brachial plexus of nerves.

ARTERIES OF THE AXILLA.

The connections of the trunk of the axillary artery, and the distribution of most of its branches, can be studied in Plate ii.

- | | | |
|--------------------------------------|--|--------------------------------------|
| <i>a</i> . Axillary artery. | | <i>e</i> . External mammary branch. |
| <i>b</i> . Superior thoracic branch. | | <i>f</i> . Subscapular branch. |
| <i>c</i> . Acromial thoracic branch. | | <i>g</i> . Dorsal branch of the sub- |
| <i>d</i> . Long thoracic branch. | | scapular. |

The *axillary artery*, *a*, crosses from the chest to the arm through the axilla; and is limited above by the lower border of the subclavius muscle, S., and below by the lower edge of the *teres major*, D. Without dissection, the situation of the vessel may be indicated by a line, on the surface of the body, from a point of

the clavicle somewhat on the sternal side of the middle of the bone, to the inner border of the coraco-brachialis muscle, K.

In a dissection carried no farther than the one from which the drawing is taken, the artery is divided into three parts by the pectoralis minor, B, viz., one part above, one beneath, and one beyond the muscle.

The upper or *first part* lies in the axillary sheath between, but deeper than its companion vein and nerves. Superficial to the sheath is the clavicular attachment of the great pectoral muscle; and underneath it is the side of the chest with the intercostal muscles of the first space, and the serratus magnus, F.

Crossing the artery, are some small branches of the companion vein and nerves;—thus directed over it from the outer side is the cephalic vein, *l*, and an anterior thoracic nerve, 3; and passing under it is the nerve to the serratus, 5.

Second part. Here the artery is covered by both pectoral muscles, large and small; but it is without muscular support behind in consequence of its position across the axilla.

The large axillary vein, *h*, has the same relative position to this as to the first part; whilst the brachial plexus, 1, dividing into pieces, is so arranged that one bundle lies outside, another inside, and a third behind the vessel.

The *third part*, twice as long as either of the others, is in contact for two thirds of its length with the pectoralis major, but thence to the ending it is covered only by the common tegumentary structures. It rests successively from above down on the subscapularis, H, the latissimus dorsi, C, and the teres major, D. To its outer side lies the coraco-brachialis muscle, K.

The position of the companion vein remains the same as above; but the connections of the nerves are altered, for the brachial plexus has divided into its terminal branches, which are placed on opposite sides of the vessel. Outside are two nerves, the musculo-cutaneous, 11, reaching only a short distance; and the median, 12, which extends throughout. Inside is the ulnar nerve, 13 (here somewhat displaced); and more or less removed from the artery, is the small internal cutaneous nerve, 9. Superficial to the artery is the large internal cutaneous, 14; and beneath

but concealed by it, the circumflex and musculo-spiral nerves—the former reaching only to the edge of the subscapularis muscle.

Number and position of the arterial offsets. Branches are distributed internally to the thorax, and externally to the shoulder and arm.

From the first part come two offsets, the highest thoracic, *b*, and acromial thoracic, *c*; the first is small and irregular in its size and position; and the latter, much larger, springs close to the edge of the pectoralis.

Only occasionally is there any named branch on the second part.

Four or five branches spring from the third part of the parent trunk. The first of these, long thoracic, *d*, is close to the border of the pectoralis minor. The next or subscapular branch arises opposite the lower border of the subscapularis muscle. Two circumflex arteries take origin near the last, but they are concealed by the trunks of the axillary vessels. The last-named branch given off is the small external mammary, *e*.

Ligature of the artery.—The axillary artery may be tied near the clavicle, as well as near the ending (p. 7).

Near the clavicle, or above the small pectoral muscle, the vessel lies deeply, and is reached only after cutting through the pectoralis major. Two offsets, superior and acromial thoracic, spring usually from this part of the artery, with the supra-scapular (a branch of the subclavian) sometimes, and they leave scarcely interval enough for the application of a ligature, especially if the first is large. The connections also of the artery with superficial vessels and nerves are so complicated (see Plate) as to render hazardous ligature of it at this spot.

The vessel might be tied in this situation for aneurism of the lower part of the arterial trunk, or for the arrest of hæmorrhage after an operation high up the arm; but the difficulties in securing the vessel, and the chances of recurring bleeding, may almost deter a surgeon from having recourse to the operation.

Should it be necessary to ligature the artery here, a practical knowledge of the anatomy will assist the operator in his attempts to secure the vessel.

With the arm outstretched, the position of the artery will be

marked by a line over the surface of the pectoralis major, which has been described already (p. 21).

The surface depressions on the sides of the clavicular attachment of the pectoralis major being taken as the limit of the incisions, the operator divides by a transverse cut near the clavicle the integuments and the thin platysma muscle, and afterwards the clavicular part of the pectoralis, looking for the cephalic vein at the outer edge of the muscle. When the thick fleshy fibres of the pectoral muscle are cut through, the subjacent fat with small veins, arteries, and nerves, ramifying in it, will appear. With much caution the surgeon finds his way amidst these dangers to the axillary sheath, V, which he opens to the necessary extent.

In the bottom of the wound the firm white brachial plexus of nerves will conduct now to the artery deeply placed between, and overlapped by the nerves and the axillary vein. The artery will be recognised by its pulsation, feel, and colour; and when it is detached from the contiguous parts, the operator may enter the aneurism needle between the vein and artery, so that the point of the instrument may be directed towards the nerves as it turns under the arterial trunk.

Aneurism of the upper part of the axillary artery is a formidable disease. It may be confined to the axilla, enlarging forwards and backwards where there is least resistance, or it may pass the bounds of that space, and project above the clavicle into the neck. As long as the disease is low on the vessel, and is confined to the axilla, ligature of the end of the subclavian artery has been resorted to in its treatment. But when it rises above the collar-bone, and the subclavian operation is rendered unsuitable or impracticable, surgeons have sometimes had recourse to the extreme measure of amputating the limb at the shoulder-joint, as there "seemed to be no alternative," to use the words of Professor Syme.

In the last-mentioned class of cases, which are so embarrassing to treat, Professor Syme recommends, that the aneurism should be laid open, and the contents removed, as in the old plan of operating on blood-tumours. From the result of two cases treated successfully in this way, he hopes that "axillary aneurism not

amenable to ligature of the subclavian artery may be remedied by the old operation ;” and he thinks that, even in cases where ligature of the subclavian is practicable, the plan recommended may be preferable.*

Branches of the artery. All the branches are distributed to the chest and the shoulder, and maintain the circulation in the limb when the parent vessel has been obliterated. The number of the named branches has been estimated differently by anatomists in consequence of their irregularity.

The *highest thoracic*, *b*, is the smallest branch, and ends on the top of the chest above the pectoralis minor.

The *acromial thoracic*, *c* (humeral thoracic, thoracic axis ?), supplies three sets of offsets, viz., external or acromial, internal or thoracic, and middle or ascending. The outer set enters the deltoid muscle ; the inner set is furnished to both pectoral muscles, a few twigs reaching the side of the chest ; and the middle set courses over the axillary sheath to the subclavius, and the pectoral and deltoid muscles.

The *long thoracic branch*, *d*, arises opposite the lower border of the small pectoral muscle, and courses along it to the fifth or sixth intercostal space, where it ends in the surrounding parts, and communicates with the intercostal arteries. In the female it supplies the breast.

The *subscapular*, *f*, a large branch, passes along the muscle of the same name to the inferior angle of the scapula, and is distributed by large branches to the contiguous muscles, serratus and latissimus, anastomosing in the first with the intercostals.

Near its beginning the dorsal scapular branch, *g*, leaves it to supply the opposite surfaces of the scapula. See Plate v.

Two *circumflex arteries* encircle the humerus, meeting on the outer side. Plate v. may be looked to for a delineation of them.

Other *muscular offsets* (not marked by letters of reference) enter the coraco-brachialis muscle.

Two occasional branches are noticed below, viz., the alar thoracic and external mammary.

* See a Paper, before referred to, on the Treatment of Aneurism, in the Medico-Chirurgical Transactions of London for 1860.

Alar thoracic. This belongs to the glands in the axilla, and is seldom to be found as a distinct branch (Quain): offsets to the glands are generally supplied by the subscapular. Plate i. If the alar thoracic exists as a separate artery, it may spring from the second or the third part of the axillary trunk.

The *external mammary, e*, appears to be a compensating branch to the long thoracic, *d*, both supplying like parts. It begins near the termination of the axillary trunk, and is accompanied by a vein, *m*.

Anastomosis of the branches. The blood finds its way from one part of the body to another through the communications of the smaller vessels, though its flow in the main trunk is obstructed; and the anastomoses of the branches of the axillary artery with those of the neck and chest, by which the collateral circulation would be established after ligature of the axillary artery, will be now considered.

On the chest the thoracic offsets of the upper thoracic, acromial and long thoracic, external mammary, and subscapular branches, anastomose with the intercostal and internal mammary arteries.

On the shoulder the branches of the axillary communicate with two branches of the subclavian trunk, viz., the posterior scapular and supra-scapular. Offsets of the subscapular artery, distributed to both surfaces of the scapula, join both the above-mentioned subclavian branches. Other anastomoses take place with the supra-scapular in the following way:—through the deltoid muscle offsets of the acromial thoracic, dorsal scapular, and posterior circumflex communicate with that artery; and through the capsule of the shoulder-joint the anterior and posterior circumflex unite with it.

VEINS IN THE AXILLA.

All the smaller companion veins which would interfere with the view of the arteries and nerves, have been taken away.

h. Axillary vein.

k. Brachial vein.

l. Cephalic vein.

m. External mammary.

The *axillary vein, h*, has the same extent as the artery by

whose side it lies, and is continuous in the limb with the superficial vein called basilic. Plate iii. Throughout its length it maintains the same position with regard to the artery, *i. e.* on the thoracic side; and it has similar connections with the parts around. Below the pectoralis minor the vein is often double, and above that muscle it has been once found divided (Morgagni).

Contributing small veins, corresponding with the branches of the artery, enter it at intervals; it receives besides near the lower border of the subscapularis muscle a trunk, *k*, formed by the brachial veins, and near the clavicle, the superficial vein of the arm—cephalic, *l*.

The *cephalic vein*, *l*, ascending over the shoulder between the pectoral and deltoid muscles, sinks through the fascia of the limb, and passing under the great pectoral, pierces the axillary sheath to reach its destination. Its position to the axillary artery has been specially described.

NERVES IN THE AXILLA.

With the exception of one lateral cutaneous nerve of the thorax, all the nerves here represented are derived from the brachial plexus.

- | | |
|---|--|
| 1. Brachial plexus. | 9. Small internal cutaneous. |
| 2. Thoracic offsets of the plexus. | 10. Nerve to the teres major. |
| 5. Nerve to the serratus magnus. | 11. Musculo-cutaneous nerve. |
| 6. Nerve to the latissimus. | 12. Median nerve. |
| 8. Lateral cutaneous of the second intercostal. | 13. Ulnar nerve. |
| | 14. Large internal cutaneous of the arm. |

The *brachial plexus* of nerves, 1, furnishes offsets to the chest, shoulder, and arm. Placed on the outer side of the first part of the artery, it surrounds the second part with its large trunks, and terminates in branches for the arm, which lie around the third part of that vessel. The following are its offsets to muscles bounding the axilla.

Anterior thoracic nerves are two or three in number. Two, 2, 3, come from the outer part, and one, 4, from the inner part of the

plexus, and supply the pectoral muscles : the small pectoral receives its offsets at the under surface from the nerve marked 4.

Nerve to the serratus magnus, 5, comes from the plexus above the clavicle, and may be seen ramifying in its muscle.

Nerve to the latissimus dorsi, 6, enters opposite the axilla the under surface of its muscle.

The *nerve to the teres major* and *subscapularis*, 10, belongs specially to the first muscle, giving only a small piece to the latter ; for the subscapularis is supplied higher up in the axilla by an offset of the plexus.

The remaining branches of the brachial plexus are continued to the upper limb, viz.

The *small internal cutaneous*, 9, (nerve of Wrisberg), communicates in the axilla with the second intercostal nerve, 8.

The *musculo-cutaneous*, 11, pierces the coraco-brachialis. The *median*, 12, the *ulnar*, 13, and the *large internal cutaneous*, 14, lie by the side of the axillary artery, and will be traced afterwards in the limb. The remaining two branches of the plexus, circumflex and musculo-spiral, are concealed by the great axillary vessels.

Remarks on the plexus.—A tumour in the axilla compressing any of the surrounding nerves may occasion pain or dulness of feeling, according to the degree of injury, in the part to which the nerve or nerves affected by it may be distributed.

In dislocation downwards of the humerus into the arm-pit, the head of the bone pressing on the nerves which lie along its inner side, occasions the pain or numbness in the limb.

In the flap amputation of the shoulder joint, the large vessels and nerves are cut last as the knife forms the flap on the inner side : and the nerves, not contracting after division like the other structures, reach to the end of the flap, and may be involved in the cicatrix left after the wound is healed, if they are not cut shorter.

One *lateral cutaneous nerve* of the thorax, 8, has been left to show its connections with the nerve of Wrisberg, 9. Sending a communicating offset to this nerve in the axilla, it is continued onwards to the integuments of the arm as the intercosto-humeral.

LYMPHATIC GLANDS IN THE AXILLA.

One of the highest of the group of lymphatic glands by the side of the axillary vessels is shown in position on the side of the chest. Two small lymphatic vessels ascend from it, and pierce the inner side of the axillary sheath to join the deep lymphatics of the neck.

DESCRIPTION OF PLATE III.

A DISSECTION of the superficial veins and nerves in front of the bend of the elbow is represented in this Plate, for the purpose of illustrating the operation of blood-letting.

For the dissection a longitudinal incision was carried over the middle of the joint, and was limited by a transverse cut at each end. On reflecting the two flaps of skin, the subcutaneous vessels and nerves will be found in the fat. A piece of the deep fascia should be raised, as may be seen in the drawing, to show the position of the deep artery and nerve.

BICEPS MUSCLE AND THE FASCIA OF THE ARM.

The deep fascia of the limb deserves special attention, as it is the only protecting layer between the cutaneous veins and the main artery of the arm.

- | | |
|--|---|
| A. Biceps muscle. | D. Inner intermuscular septum. |
| B. Deep or special fascia of the arm. | F. Projection of the inner condyle of the humerus. |
| C. Piece of the deep fascia reflected. | I. Intermuscular space on the front of the forearm. |

Biceps muscle, A. At its lower end the muscle diminishes in size, and becoming tendinous, is fixed into the radius. Higher in the arm it gives rise to the well-known prominence, with a groove or hollow on each side lodging the superficial veins of the arm, viz., the basilic, *b*, on the inside, and the cephalic, *k*, on

the outside. The swell of the muscle serves as a guide to the brachial artery along its inner edge.

The *deep fascia*, or the aponeurosis of the limb, invests closely the arm, and is pierced here and there by the nerves and vessels of the integuments. Its component fibres take different directions, some being transverse, others oblique ; and it is joined at spots by offsets from the tendons of the muscles. One such offset, added to it from the tendon of the biceps in front of the bend of the elbow, gives it increased strength between the deep artery, *l*, and the superficial median basilic vein, *g*.

On each side of the arm is a thickened part, which is fixed to the humerus between the flexor and extensor muscles, and is called intermuscular septum : these processes are attached to the condyloid ridges of the bone ; and the inner one, best developed, is marked by the letter D.

Near the bend of the elbow, where the piece of the fascia is reflected, the contiguity of the underlying brachial artery may be observed.

The fascia is prolonged over the muscles to the forearm ; and appearing through it below the elbow is a well-marked yellow line, *I*, pointing to an intermuscular space which contains the upper end of the radial vessels.

Straightening the elbow-joint increases, and bending the joint relaxes the tightness of the fascia. So the pain consequent on tension of the fascia from accumulation of blood or other fluid beneath it, or from swelling of the parts enclosed by it, may be relieved by placing the limb in a bent position.

SUPERFICIAL VEINS OF THE ELBOW.

Great irregularity prevails in the arrangement of the superficial veins in front of the elbow. The condition of them depicted in the Plate is not quite usual, though it is sufficiently regular for the purpose of describing their anatomy.

- a*. Median vein of the forearm.
- b*. Anterior ulnar veins.
- c*. Posterior ulnar veins.
- d*. Radial vein of the forearm.

- f*. Median cephalic vein.
- g*. Median basilic vein.
- h*. Basilic vein of the arm.
- k*. Cephalic vein of the arm.

The *median vein*, *a*, lies along the middle of the forearm, and divides near the bend of the elbow into two, viz., an outer, the median cephalic vein, *f*; and an inner, the median basilic vein, *g*, into which the other veins of the forearm open. At its ending the median communicates with a deep vein through the fascia.

Anterior and posterior ulnar veins, *b*, and *c*, gather the blood from the opposite surfaces of the inner half of the forearm, and both join the median basilic, *g*,—the anterior ulnar entering about the middle, and the posterior ulnar at the ending of that vein.

The *radial vein*, *d*, ramifies on the back, and outer part of the forearm, and opens into the end of the median cephalic, *f*. Oftentimes this vein is very small; or it may be wanting.

The *median cephalic vein*, *f*, reaches from the point of splitting of the median, *a*, to the outer border of the limb, where it unites with the radial, *d*, and forms the large cephalic vein, *k*. It crosses the limb obliquely in the hollow between the prominent biceps and the external muscles of the forearm. Underneath it lies the large external cutaneous nerve, *3*, and over it pass some offsets of the same nerve. Generally this vein is the smallest of the two pieces into which the median divides, and is sometimes absent.

A moderately tight bandage round the limb just above the elbow, as in the operation of bleeding, does not stop the flow of blood in the median cephalic vein in a muscular arm in consequence of the projection of the biceps arresting the pressure of the band. But the current of blood in the vessel may be commanded by the thumb inserted into the hollow outside the biceps, and pressed downwards steadily.

The *median basilic vein*, *g*, is directed inwards from the median vein, *a*; and uniting with the posterior ulnar veins, *c*, gives rise to the basilic vein, *h*. Usually longer and larger than the median cephalic, it is commonly more transverse in its direction, and is firmly supported by the subjacent fascia and muscle. Joining it below are the anterior ulnar veins. The chief branches of the large internal cutaneous nerve, *1*, lie under, and smaller offsets over the vein; but in this dissection the main part of the nerve was

superficial to the vein. In the line of the yellow space, I, under the fascia, the brachial artery, *l*, crosses underneath the median basilic vein, the two being separated only by the aponeurosis of the limb somewhat thickened by the prolongation from the tendon of the biceps.

This vein being well supported underneath, the current of blood in it can be readily stopped by the thumb or finger, or by a band round the arm above the elbow compressing the basilic vein.

The *basilic vein*, *h*, begins at the point of union of the median basilic, *g*, with the posterior ulnar veins, *c*. Ascending through the lower part of the arm in the groove or depression inside the biceps, it sinks under the fascia half way up the arm, and becomes the axillary vein.

The *cephalic vein* of the arm, *k*, formed, as before said, by the junction of the median cephalic, *f*, with the radial vein, *d*, continues on the outer side of the biceps as far as the shoulder, and ends in the axillary vein. See Plate ii., *l*.

Blood-letting is practised commonly in the veins in front of the elbow. Either the median basilic, *g*, or the median cephalic, *f*, is selected for venesection according to its size; and the median basilic is most frequently opened in consequence of its being the largest, and on account of the readiness with which it may be fixed and compressed against the firm supporting parts beneath. If the operation is to be performed by the student for the first time, the following directions may be of use.

To stop the flow of blood in the superficial veins, a narrow band or fillet is to be tied around the arm from two to three inches above the elbow. This band should not be drawn too tightly, as moderate pressure will arrest the current of blood in the veins; and too great tightness will compress the brachial artery in thin persons, and prevent the free entrance of the blood into the limb below the elbow. After the bandage has been applied, the state of the arteries should be examined, to ascertain that the pulse beats with the same force and frequency as in the other arm; for if the pressure diminishes the current of blood in the main artery, a full stream will not be maintained through the opening made into the vein.

Supposing the median basilic vein, *g*, to be selected for venesection, the position of the brachial artery is to be ascertained by the pulsation, and the vein is not to be opened directly over the beating artery. After this examination the operator stands on the inner side of the limb and grasps the forearm near the elbow with his hand, placing the thumb in front ; and, using his left hand for the right arm, and the opposite, he will hold the lancet in the left hand when taking blood from the left limb. With slight pressure of the thumb the vein is now to be fixed ; and if this step is omitted, the point of the lancet only punctures and pushes aside the full and freely moveable vein. The aperture into this vessel is to be made close to the thumb, both the skin and the vein-wall being divided obliquely to the same extent ; and it should be large enough to prevent the blood clotting, and closing it too soon. To give the necessary size (about a quarter of an inch) the lancet is first to be pushed downwards, and is next to be made cut its way to the surface, in order that the structures may be divided from within out ; for if the point of the instrument is thrust in and drawn out, making a punctured wound, only a very small quantity of blood will flow through the opening before this is narrowed or stopped by coagulating blood. As the walls of the vein are approximated by the compression of the thumb, too deep an insertion of the lancet may cut through the vein, causing effusion of blood beneath with resulting obstruction to the issuing current ; and the operation may be accompanied by puncture of the subjacent brachial artery.

The operator does not relinquish his hold of the arm and his control of the vein (for only a few drops of blood will escape till the thumb is removed) until he has had time to put his lancet away, and bring the receiving basin into the proper position. After instructing the person being bled, not to move the arm with the view of trying to direct the jet of flowing blood, he takes his thumb off the vein, and allows the blood to issue in a full stream, though he still supports the limb in his own hand. Leaving the control of the limb to the patient, as when a stick is grasped by the hand, will oftentimes cause the flow of blood to cease ; because in his attempts to direct the current of blood into the basin he

alters the position of the arm, and the opening in the vein is closed by the skin being brought over it.

Should this displacement of the skin take place, the blood accumulates under it, forming a tumour called "thrombus," and compresses the vein.

When sufficient blood has been obtained the thumb is to be placed on the vein, as before, close below the opening, for the purpose of stopping the bleeding, and the bandage is to be loosened. A small compress of linen, made ready before the operation is begun, is to be placed on the wound ; and is to be fixed in position by the fillet applied like a figure of 8 around the elbow whilst the limb is slightly bent. Slight pressure of the bandage, a half bent state of the elbow, and rest, are most conducive to the healing of the wound.

If the median cephalic, *f*, should be selected for venesection in consequence of its greater size, the steps to be taken in the operation are the same as those above referred to, with the exception of the manner in which the current of blood in it is to be checked. Tying up the limb in the usual way will scarcely make pressure enough upon the median cephalic in a muscular arm, because the vein sinks into the hollow on the side of the biceps. A more effectual compression may be exerted by sinking the thumb in the groove between the biceps and supinator longus muscles ; or if a fillet is used, by inserting under it a small compress over the situation of the vein. In consequence of its position in a hollow, the vein may be rather more difficult to reach with the lancet, especially in a fat person.

From the position of the brachial artery under the median basilic vein puncture of it may take place in the operation of bleeding. This serious accident is occasioned by cutting the vein directly over the artery, and pushing the lancet too deeply after transfixing the vein. Injury of another artery may ensue under the following circumstances. One of the large arteries of the forearm (radial or ulnar) may arise higher in the arm than usual, and in passing the elbow to its destination, may lie superficially, — being placed generally under the aponeurosis of the limb, but sometimes in the fat, by the side of the

veins.* When it is contained in the integuments, its projection in a fat arm might be taken for the swell of a vein on an insufficient examination. The occasional existence of such a state of the arteries should lead to a careful examination of the front of the elbow before venesection, with the view of detecting pulsation not only in the brachial trunk, but also in any other unusually placed artery.

Injury of an artery in blood-letting would be manifested by the blood being redder than ordinary venous blood ; by the fluid escaping in jerks ; and by pressure on the vein below the opening not stopping the bleeding. Such an untoward accident should be met by placing a conical compress on the wound ; and by applying a bandage firmly along the limb with the intention of preventing the escape of the blood, and its accumulation under the deep fascia.

As the wound in the artery does not heal readily, like that in the skin and the vein for instance, a blood-tumour or aneurism usually follows. Into this tumour the blood passes through the hole in the artery, and it is inclosed in a sac formed by the surrounding parts (false aneurism).

Or the wound in the back of the vein not healing, a permanent communication with the artery is established, through which the arterial blood is driven into the vein, producing distension, and a varicose condition of the superficial veins below the elbow. If the edges of the contiguous openings in the vessels unite without the intervention of any sac, so that the vein receives blood directly from the artery, the term aneurismal varix is applied to that condition of the parts. If, on the contrary, a sac or tumour is formed between the artery and vein, which communicates with both, and serves as a channel by which the arterial current can pass into the vein, the aneurism is called varicose.

For the treatment of a blood tumour or aneurism formed after bleeding, whether it opens only into the artery (traumatic false aneurism) or joins both the artery and the vein (varicose aneurism), an operation on the brachial artery will be needed if its en-

* Surgical Anatomy of the Arteries, by Professor Quain.

largement cannot be controlled by pressure. And the operation suited for the cure of the disease would be that of opening the tumour, and applying a ligature above and below the wound in the artery. If the tumour is somewhat solidified by the deposition of laminated fibrin in it, ligature of the brachial artery in the middle third of the arm would be had recourse to by some surgeons. But the safer practice seems to consist in tying the vessel at the wounded part as a rule ; and this treatment would be most suitable also for aneurism connected with a wound of the radial or the ulnar artery in consequence of its unusual origin, and its superficial position in the fat in front of the elbow. Professor Syme advocates cutting down upon the tumour in aneurism from a wound of the brachial in front of the elbow. He says : " I have treated all the aneurisms at the bend of the arm, resulting from wound of the humeral artery through venesection, which have come under my care, amounting to ten in number, by opening the sac, and applying ligatures on both sides of the aperture."*

In the aneurismal varix equable pressure on the limb, which will check the arterial blood entering the tube of the vein to any great extent, may do away with the necessity of any operative proceeding. Should the disease be a source of suffering, and interfere with the use of the arm, as in a labouring man for example, it may be readily cured by ligature of the artery at the part wounded.

In venesection puncture of a nerve will sometimes cause great pain. In the Plate several branches of the internal cutaneous nerve cross the median basilic vein, and any of these might be injured ; but as their position cannot be ascertained during life, no precaution can be taken to avoid them. Commonly the puncture occasions only pain at the time of bleeding, though in some conditions of the body it may give origin to serious general disturbance of the health.

Inflammation of the vein or phlebitis may result from bleeding ; it will require the treatment appropriate to that affection.

* The Paper on the Treatment of Aneurism before referred to. *Medico-Chirurgical Transactions*, 1860.

Several other diseased states produced by venesection, with their treatment, were described by Abernethy ; and the student who is desirous of obtaining further information may look to the essays of that surgeon.*

The student should observe scrupulously the injunction—never to bleed with a lancet that has been used for other purposes.

BRACHIAL ARTERY AT THE ELBOW.

The lower end of the brachial artery, *l*, which lies under the superficial veins, and may be wounded in venesection, has been laid bare by reflecting a piece, *C*, of the deep fascia.

In this situation the artery is very near the surface of the limb, and is covered only by the integuments and the deep fascia, *B*. Along its outer side is the biceps muscle, *A*, which will serve as the guide to the vessel. Underneath it lies the brachialis anticus muscle (Plate iv., *F*).

One large accompanying nerve, median, *8*, is placed on the inner side of the artery, and the median basilic vein crosses over it.

Only superficial offsets are furnished to the integuments from this part of the vessel.

Ligature of the artery at the elbow may be necessary in consequence of a wound with a lancet in venesection, or with any other cutting instrument.

In the case of a wound from accident the vessel requires to be secured by one thread above and another below the injury ; and with the surrounding textures infiltrated with blood, the surgeon may experience some difficulty in finding the ends of the vessel, unless he has studied the connections, and practised previously the operation of applying a ligature to the artery in the dead body.

In an operation here for aneurism after a wound, as when the vessel is punctured in venesection, the tumour is to be opened, and the contents of the sac being removed, the arterial trunk is to be tied above and below the opening in it.

* Surgical Observations on Injuries of the Head and on Miscellaneous Subjects, by John Abernethy, F.R.S. ; 4th Edit. p. 135 : London, 1825.

Cutting down to the artery in front of the elbow is an easy operation in the dead body. Taking the inner edge of the biceps muscle as the superficial guide to the position of the vessel, an incision two or three inches in length, and parallel to the artery, may be carried along the biceps, so as to divide the integuments ; and should the median basilic vein come into view at this stage, it may be drawn inwards. The deep fascia is next to be cut to the same extent, and the wound is to be moved inwards over the line of the artery.

Deep in the wound the firm white median nerve appears on the inner side of the artery, but gradually inclining away from it in front of the elbow-joint : this nerve will serve as the deep guide to the position of the vessel, though the operator should be aware that it may be placed away from the artery, lying along the inner intermuscular septum of the arm.* The nerve being recognised, the artery is to be sought between it and the edge of the biceps.

Lastly, the sheath of the vessel having been opened, and the venæ comites separated from the artery, the aneurism needle may be passed, and the ligature may be tied in the usual way.

Some unusual conditions of the arteries in front of the elbow deserve consideration with reference to the operation of blood-letting. The occasional presence of an artery in the fat with the superficial veins has been before noticed, p. 34. The number of large arteries too beneath the fascia may vary. Commonly there is only one, the brachial ; but there may be two, which consist of the brachial trunk and the radial or ulnar ; and lastly, three may be occasionally found, resulting from division of the brachial into its usual arteries rather above the elbow-joint, and the unusual origin of the interosseous from the brachial high in the arm.† The possibility of so many arteries being present in one spot must suggest caution to the student about to bleed, and to the surgeon

* I have met with three examples of this condition in the dissecting-room of University College. In another body the nerve was deeper than the artery, and was covered, above the elbow, by fibres of the brachialis anticus.

† The facts here referred to shortly, are stated fully in the Surgical Anatomy of the Arteries by Professor Quain, p. 259.

undertaking the operation of placing a ligature on a wounded artery in front of the elbow.

There is another unusual state of the brachial artery which would give rise to unlooked-for hæmorrhage from a wound in the lower half of the arm. For instance, the artery leaves sometimes the edge of the biceps, and courses, with or without the median nerve, along the line of the inner intermuscular septum, D. At the elbow it returns to the middle of the limb through the origin of a wide pronator teres muscle, or round a projecting bony point of the humerus (Quain). In such a deviation in the course of the artery, a wound near the elbow on the inner side of the arm, far removed from the line of the biceps muscle, might open this large trunk, and give origin to most alarming, if not dangerous hæmorrhage.

NERVES BEFORE THE BEND OF THE ELBOW.

The anterior cutaneous nerves of the forearm cross the superficial veins in front of the elbow in coursing to their destination.

- | | |
|---|--|
| <ul style="list-style-type: none"> 1. Large internal cutaneous nerve. 2. Small internal cutaneous, or the nerve of Wrisberg. 3. External cutaneous nerve. 4. Anterior part of the large internal cutaneous. | <ul style="list-style-type: none"> 5. Cutaneous offsets to the arm of the internal cutaneous. 6. Posterior part of the internal cutaneous. 8. Median nerve. |
|---|--|

The *large internal cutaneous nerve*, 1, enters the fat about midway along the arm, and divides into two parts:—One, 4 (the anterior part), is continued along the front of the forearm to the wrist; the other, 6 (posterior part), ramifies on the back of the forearm on the ulnar side, reaching to the lower third. The primary branches of the nerve lie generally under the median basilic vein, instead of over it as in this dissection.

Near the arm-pit a cutaneous offset, 5, leaves the trunk to supply the integuments over the biceps muscle.

Small internal cutaneous nerve, 2, or the nerve of Wrisberg. The origin of the nerve is seen in the arm-pit in Plates i. and ii. It pierces the fascia internal to, and lower down than the large

cutaneous nerve, 1 ; and it ends in the integuments over the back of the elbow. Offsets are directed backwards to the fat and skin of the lower part of the posterior surface of the arm ; and one or two communicate with the large internal cutaneous nerve.

In this body the nerve was large, and was placed rather farther forwards than usual.

The *external cutaneous nerve*, 3, or the terminal part of the musculo-cutaneous (Plate ii., 11), appears at the bend of the elbow beneath the median cephalic vein, ^{gives off small post.} and is distributed along the radial side of the forearm ^{anterior} as far as the ^{posterior} ball of the thumb.

The *median nerve*, 8, is continued to the fingers. At the upper part of the dissection it lies inside and near the brachial artery, but opposite the bend of the elbow it begins to incline inwards from that vessel. In the lower as in the upper part of the arm the nerve serves to guide the surgeon to the situation of the large vessel of the limb.

DESCRIPTION OF PLATE IV.

THE relative position of the muscles, vessels, and nerves of the inner side of the arm, after the removal of the integuments and the deep fascia, is shown in this Plate.

The skin may be reflected in two flaps to the sides, by an incision along the centre of the arm, with a cross-cut at each end. In the fat the superficial nerves and vessels are to be found ; and then the remains of the fat, and the deep fascia, should be taken away. A small part of the fascia has been left near the elbow, for the purpose of marking its position to the superficial veins and the lymphatic glands.

SURFACE MARKING OF THE ARM.

Along the front of the arm is the well-marked muscular prominence so evident in the Plate. Before the removal of the integuments and fascia, this eminence seems to the feel to be

formed by one muscle ; but after the dissection has been made, it will be seen to consist of the biceps, D, and coraco-brachialis, H, which may be traced upwards under the anterior fold, R, of the arm-pit. As the chief muscle, D, acts as a flexor of the elbow-joint, it becomes much enlarged in persons occupied, like blacksmiths, in bending the elbow.

On each side of the swell of the muscles is a surface depression : the two meet below in a hollow in front of the elbow, which contains the superficial veins and nerves ; but above they separate, the inner one joining the arm-pit, and the outer one subsiding at the insertion of the deltoid muscle, S.

In the inner depression, which is most marked, lies the basilic vein, *g*, with the large internal cutaneous nerve, 4, and lymphatics : these are contained in the fat, and are usually distant a short way from the edge of the biceps. Beneath the fascia of the limb and close to the muscle are lodged the brachial vessels, *k*, and the companion median nerve, 7.

The outer depression is less wide and deep, and corresponding with it is the superficial vein, the cephalic, *h*. In it, towards the elbow, the external cutaneous nerve of the forearm makes its appearance through the fascia (Plate iii. 3).

Wounds in the outer bicipital hollow may be large and deep without injuring any important part ; whilst in the inner one scarcely a puncture can be made without endangering some vessel or nerve. The issue, seton, and cautery are applied usually at the top of the outer bicipital groove, just below the insertion of the deltoid muscle, because the spot is free from any active subjacent muscle to give rise by its contractions to pain in the sore that has been produced.

MUSCLES AND FASCIA OF THE ARM.

The muscles on the front of the humerus which pass over the elbow, viz., the biceps, D, and the brachialis anticus, F, bend the elbow-joint by bringing forwards the bones of the forearm, to which they are fixed. Behind the humerus is a large three-headed or tricipital muscle which is attached to the ulna, and,

drawing backwards that bone, acts as an antagonist to the flexor muscles.

- | | |
|---|--|
| <p>A. Fascia of the forearm.
 B. Offset to the fascia from the tendon of the biceps. (<i>semilunar</i>)
 C. Inner intermuscular septum of the arm.
 D. Biceps flexor brachii muscle.
 F. Brachialis anticus muscle.
 H. Coraco-brachialis muscle.</p> | <p>K. Inner head of the triceps extensor muscle.
 M. Middle head of the triceps.
 N. Teres major muscle.
 P. Latissimus dorsi muscle.
 R. Pectoralis major muscle.
 S. Deltoid muscle.</p> |
|---|--|

The *deep fascia* of the arm is continuous with that of the forearm, A, and is attached to the prominences around the elbow. C marks the inner intermuscular septum of the arm, which is inserted into the condyloid ridge of the humerus, and gives origin in front to the brachialis anticus, F, and behind to the inner head of the triceps, K. In front of the septum a piece of the fascia has been left with superficial lymphatic glands on it. At B, an offset from the tendon of the biceps joins the fascia.

Biceps brachii muscle, D. The origin by two heads from the scapula, is shown in Plate ii. Half way along the arm the heads blend in a fleshy belly; and the muscle is inserted below by a tendon into the tubercle of the radius, after giving a fibrous process, B, to the deep fascia. A third slip or head arises occasionally from the middle of the humerus; and if it crosses over the main vessels, as it is directed outwards, it may complicate the operation of tying the artery.

Except at the origin and insertion the muscle is superficial; and it covers partly the other two muscles in front of the humerus, viz., the coraco-brachialis, H, and brachialis anticus, F. Along the inner edge lie the brachial artery, *k*, and the accompanying veins and nerves; and along the outer edge is the cephalic vein, *h*.

The muscle flexes the elbow-joint by acting on either the radius or the humerus, according as the one or the other may be free to be moved. It is also a supinator of the hand. And if the radius is fixed it can assist in carrying the limb forwards from the side. As the muscle contracts in the living body the swell of its belly rises towards the pectoralis major.

The *brachialis anticus*, F, arises from the front of the humerus for the lower half of the bone ; and from the intermuscular septum on each side, viz., from all the inner one, but from only the upper part of the outer one, some muscles of the forearm excluding it below (Plate xii.). It is inserted into the fore part of the coronoid process of the ulna.

Resting on the humerus and the elbow-joint, it is concealed by the biceps, and vessels and nerves. Sometimes a fleshy slip from it covers the brachial artery or the median nerve at the lower part of the arm.

This muscle reaches over the elbow, and is the chief agent in bending that joint.

The *coraco-brachialis muscle*, H, is shown better in Plate ii., to which reference may be made.

The *triceps extensor cubiti* consists above of three parts or heads ; and its anatomy will be given more fully in the description of Plate vi.

The middle head, M, arises from the scapula ; and the inner and outer heads are attached to the humerus and the intermuscular septa. The insertion of the muscle into the olecranon process of the ulna will be afterwards seen.

In this view of the parts the middle head lies beneath the *teres major*, N, and *latissimus dorsi*, P, and touches the brachial vessels and their companion nerves for one to two inches. And the inner head surrounds the ulnar nerve, 8, and the inferior profunda artery, *n* : this is more evident in Plate vi.

The *teres major*, N, and *latissimus dorsi*, P, coming forwards to their insertion into the humerus, bound behind the hollow of the axilla (Plate i.).

The *pectoralis major*, R, curves over the muscles of the front of the arm as it passes from the thorax to its insertion into the humerus. At its attachment to the bone, it joins the deltoid muscle, S.

VEINS OF THE ARM.

The superficial veins of the limb diminish in number from the hand upwards. At the elbow they blend into two, which have a

constant course on the sides of the biceps muscle to the axilla. A somewhat different arrangement from that in Plate iii. is here noticeable. *depicted.*

a. Median vein of the forearm.
b b. Anterior ulnar veins.
c. Posterior ulnar vein.
d. Median cephalic vein.
f. Median basilic vein.

g. Basilic vein of the arm.
h. Cephalic vein of the arm.
s. Inner companion vein of the brachial artery.

The *median vein*, *a*, splits in the usual way into two branches, which are directed outwards and inwards to receive the radial and ulnar veins. In this body the anterior ulnar veins, *b, b*, are large, and join the median basilic, *f*, at separate points, after being united by a cross branch.

The *basilic vein*, *g*, formed by the union of the median basilic and anterior ulnar veins near the elbow, ascends in the fat to the middle of the arm; then piercing the deep fascia, it is directed onwards to the axilla by the side of the brachial artery, and becomes the axillary vein at the lower border of the *teres major* muscle. Soon after it sinks through the fascia it communicates usually with one of the companion veins, *s*, of the brachial artery.

Cephalic vein, h.—Only the upper part of this vein is visible as it crosses between the muscles great pectoral, *R*, and deltoid, *S*, to end in the axillary vein. Springing below from the junction of the median cephalic, *d*, with the radial vein, it ascends in the fat to the shoulder outside the biceps muscle. An unusual superficial artery accompanied it in this dissection.

Venæ comites.—The companion veins of the brachial artery, two in number, lie one on each side of that vessel, and join at intervals by cross branches; the inner one is marked *s* in the Plate. Receiving small veins which accompany the branches of the artery, they join commonly into one at the lower part of the axilla; and this ends in the axillary vein near the lower border of the subscapularis muscle (Plate ii. *k*).

ARTERIES OF THE ARM.

The brachial artery and the end of the axillary trunk may be studied in this dissection with their connections undisturbed. The ramifications or ending of the branches must be learnt with the aid of the other Plates.

k. Brachial artery.

* Spot best suited for ligature of the vessel.

l. External mammary branch of the axillary artery.

m. Muscular offset of the superior profunda branch.

n. Inferior profunda branch.

p. Anastomotic branch.

The *brachial artery*, *k*, extends from the lower border of the *teres major* muscle, *N*, to a finger's breadth below the bend of the elbow (Quain), where it bifurcates into the radial and ulnar arteries. The inner edge of the muscular prominence of the *coraco-brachialis* and *biceps* marks its position in the limb; or a line from the arm-pit to the middle of the bend of the elbow would correspond with the course of the vessel.

In consequence of its superficial position in the arm the vessel can be readily compressed. Above the spot marked with an asterisk the artery lies inside the humerus, and pressure to act on it should be directed outwards against the bone; but below that spot it inclines in front of the bone, and the blood will be stopped in it by forcing backwards the fingers or the thumb.

Its connections with muscles and fascia are the following:—Beneath it, from above down, are the long head of the *triceps*, *M*; the inner head, *K*, of the same muscle; the *coraco-brachialis*, *H*, where the asterisk is placed; and thence to the ending, the *brachialis anticus*, *F*. Superficial to the artery is the deep fascia of the limb with the integuments.

Two companion veins are close to the brachial trunk—one on each side—and anastomose across it after the manner of such veins; and at the bend of the elbow the median basilic vein, *f*, crosses the artery. The basilic vein, *g*, lies inside the line of the vessel—sometimes nearer, and at others farther from it.

Several nerves accompany the artery above, but only one below.

The median nerve, 7, keeps close to the vessel throughout, except in front of the elbow, where it inclines away to the inner side ; as low as the part marked thus * it is outside the vessel, then it crosses gradually over, though occasionally under the artery, and gains the inner side about two inches above the elbow. The ulnar nerve, 8, lies inside and in close contact with the artery nearly to the asterisk, but at that spot it diverges from the vessel and courses along the inner intermuscular septum. The musculo-spiral nerve is placed behind the upper part of the artery for two inches (see Plate vi.). The large internal cutaneous nerve, 4, rests on the upper third of the brachial artery ; but in some bodies it is moved farther in, as in the dissection from which the drawing was taken.

Position and names of the branches. Besides small muscular and cutaneous offsets, four named branches spring from the brachial trunk. The highest and largest, *upper profunda*, leaves the back of the artery about an inch from the beginning. The next largest, the *inferior profunda*, *n*, arises near the upper end of the inner intermuscular septum. A *nutritive artery* of the shaft of the humerus begins near the last, and is covered by the biceps. Another small branch, the *anastomotic artery*, *p*, comes from the parent trunk near the elbow.

All the branches are small except the superior profunda ; and no two arise at opposite sides of the trunk to interfere by a cross current with the healing process after a thread has been put on it. Almost any point would therefore be available for the application of a ligature ; but the spot generally selected is marked with an asterisk in the Plate, the vessel being here free from any large offset, and being firmly supported by the coraco-brachialis and the humerus.

Ligature at the middle of the artery. This operation on the brachial trunk, without a wound at the spot where it is tied, is sometimes rendered necessary by an aneurism, or by hæmorrhage from a vessel lower in the limb.

Under ordinary circumstances the operation is not difficult, as the brachial trunk is so near the surface, and the guides to the vessel are good. The superficial guide to the position of the

artery is the inner edge of the biceps muscle ; and the deep guide during the operation is the large median nerve.

When the vessel is to be secured the operator stands on the inner side of the limb, and fixing his eye on the spot thus marked *, makes a cut two to three inches long on the biceps muscle near the inner edge, but not over the vessel. The skin, fat, and deep fascia are to be divided down to the fleshy fibres ; and the incision is then to be moved inwards over the line of the brachial artery, the loose skin readily allowing this shifting of its position.

Bending now the elbow, to relax the biceps muscle and allow of its being kept out of the way, the firm median nerve is to be looked for close to the edge of the biceps, where it lies outside the vessel, or is coming inwards over the arterial trunk. The median nerve being found, and the knife having been carried along it to divide its sheath, is next to be drawn inwards from the edge of the biceps with a narrow retractor, but special care must be taken not to drag the artery out of place with the nerve. Within the space limited by the nerve on the one side and the muscle on the other, the operator seeks the artery by cutting away the fat bit by bit.†

Supposing the artery recognised, its sheath is to be seized with the forceps, and a piece is to be cut out, care being taken that the point of the scalpel does not injure the vessel beneath. Without loosing the sheath from the forceps a blunt instrument, like the point of a director, may be inserted into the hole of the sheath to separate the artery ; and on its withdrawal the aneurism needle is to be carried round the vessel in the same channel. The surgeon avoids detaching the artery from its sheath more than is required for the passage of the needle ; for separation of the two destroys the vasa vasorum, occasioning the death of the

† Some experience in superintending the operations of students on the dead body has convinced me of the expediency of directing the nerve to be drawn inwards. If this mode of proceeding is not adopted, the beginner comes upon the ulnar nerve and the basilic vein, which he may mistake for the median nerve and the brachial artery.

arterial coats, and, as a consequence, hæmorrhage may follow the coming away of the ligature.

Let the ligature be put on the vessel as high as the sheath is detached ; and before tying it, pressure should be used for the purpose of ascertaining whether the circulation through the chief vessels of the limb can be arrested. Should the pulse still beat as before at the wrist, the existence of more than one arterial trunk may be suspected ; and the operator, after tying the one, seeks another by its side. If two arteries are present both are to be secured ; for the object in view when putting a ligature on the brachial trunk, is to stop the entrance of the blood into the limb through the main vessel, and to ensure its coming in only slowly, and through the anastomosing channels.

Before an attempt is made to place a ligature on the brachial trunk, the difficulties likely to arise from different states of the artery or of the surrounding parts should be well considered.

An unusual position of the brachial artery has been observed. In the condition referred to the vessel separates from the biceps above, or about midway between the arm-pit and elbow, and courses through the arm along the inner intermuscular septum, C (p. 39). So, in an operation at the usual spot, if the main blood-vessel cannot be found by the side of the muscle, it should be sought further in, or nearer the inner border of the limb.*

There may be more than one large artery in the limb as before said. Two vessels have been found as frequently as 1 in 5, and the surgeon may expect therefore to meet with this condition.† When two vessels are present they usually lie side by side in the place of the brachial ; and their existence might be inferred in an operation in consequence of the smaller size and more superficial position of the vessel first found. But sometimes the two are

* Two instances of this kind were met with during operations on the dead body, and have been put on record by Mr. Quain : "Commentaries on the Arteries," p. 259. I have observed a similar unusual place of the artery, with difficulty in finding the vessel, whilst I was engaged in superintending the operations of students.

† The Anatomy of the Arteries, by Mr. Quain.

not in contact with each other : thus, one, the smallest (radial) may lie in the place of the brachial trunk ; and the other, the larger artery, may be moved inwards from the edge of the biceps to the inner intermuscular septum.

The depth of the artery varies with different states of the biceps muscle. Sometimes the brachial trunk is covered, at the spot where ligature is practised, by a fleshy slip of origin of the biceps from the humerus. The presence of fleshy fibres over the artery would cause some embarrassment to an operator unacquainted with that fact ; and the knowledge of the occasional existence of this condition teaches, that a previous examination of the arm should be made, with the view of detecting it by the difference in the force of the pulsations of the artery.

Change in the position of the median nerve with respect to the brachial artery may bring danger in an operation, as the nerve serves as the deep guide to the vessel. In the ordinary arrangement the nerve is superficial to the artery, and is met with first ; but not unfrequently it crosses under the artery, and would not be found so soon as the vessel. When this last named position of the nerve exists, the danger of wounding the artery or its companion veins is increased in consequence of these being nearer the surface, and being reached unexpectedly.

Branches of the artery.—The offsets of the artery are small and numerous, but only a few have received names. After supplying the muscles and contiguous parts the chief branches course to the elbow, and join offsets of the trunks in the forearm.

The *superior profunda branch* arises from the trunk of the artery above the letter, *k*, and winds to the back of the arm, where it ramifies in the triceps, and ends at the elbow. (See Plate vii.) One offset is marked, *m*, in the Drawing.

The *inferior profunda, n*, arises near the spot which is commonly chosen for ligature of the trunk, and runs along the ulnar nerve to the elbow : it anastomoses with the posterior recurrent branch of the ulnar artery.

The *nutritive artery of the shaft of the humerus* arises between *k*, and *, and entering an osseous canal, supplies the medullary structure of the bone.

The *anastomotic branch*, *p*, is directed inwards through the inner intermuscular septum, and communicates with the inferior profunda, *n*. An offset descends in front of the elbow joint, supplying the brachialis anticus and one or more muscles of the fore arm, and anastomoses with an anterior recurrent branch from the ulnar artery.

Muscular offsets spring from the trunk at intervals, and supply the muscles on the fore part and the back of the humerus.

Small *cutaneous* offsets to the arm are shown coming from the end of the brachial, and the end of the axillary artery.

Anastomoses of the branches.—After ligature of the brachial artery the blood is conveyed into the limb by the anastomosis of the branches arising above, with those beyond the spot tied. Thus the superior profunda joins behind the elbow with the anastomotic and the recurrent interosseous; and on the outer side with the recurrent branch from the radial artery (Plate vii.). The inferior profunda communicates with the anastomotic, and with the posterior recurrent of the ulnar (Plate viii.). And the anastomotic branch, joining the profunda, transmits its blood to the anterior recurrent branch of the ulnar (Plate viii.). The artery entering the shaft of the humerus will anastomose above and below with the vessels supplied to the ends of the bone.

NERVES OF THE ARM.

All the nerves included in this dissection are derived from the brachial plexus in the axilla, with the exception of the small offsets over the shoulder, which come from the cervical plexus in the neck. Only a part of each trunk is laid bare, as it passes onwards to its destination in the forearm.

- | | |
|---|--|
| 1. Internal cutaneous branch of the musculo-spiral. | 5. Anterior branch of the internal cutaneous. |
| 2. Branch of musculo-spiral to the inner and middle heads of the triceps. | 6. Posterior branch of the internal cutaneous. |
| 3. Nerve of Wrisberg or small internal cutaneous. | 7. Median nerve. |
| 4. Internal cutaneous (large). | 8. Ulnar nerve. |
| | 9. Branches of the cervical plexus. |
- (Supra-acr)*

The trunk of the *musculo-spiral nerve*, lying beneath the brachial artery, furnishes a cutaneous branch, 1, to the integuments of the back of the arm; this reaches as far as the lower third, or sometimes nearly to the elbow. A muscular branch, 2, to the inner head, K, and the middle head, M, of the triceps, arises in common with the preceding. *Cour. of nerve to the inner h. = "ulnar collar" accompany ulna*

The *nerve of Wrisberg*, 3, and the *large internal cutaneous*, 4, pierce the fascia of the arm rather below the middle, and are distributed to the integuments of the back of the arm and forearm: their position internal to the brachial artery may be noticed. Usually the cutaneous nerve, 4, lies over the upper part of the artery. Its place at the elbow under the median basilic vein is regular: for another arrangement, see Plate iii. *nerve & deep part for short dist. 7*

The *median nerve*, 7, takes the same course in the arm as the brachial artery, and lies close to that vessel (p. 46). Outside the artery above, and inside below, it crosses over the blood vessel so as to be found on the inner side about two inches above the elbow. Sometimes the nerve passes under instead of over the artery in its change of position from the one side to the other. No branch is distributed from it in the upper arm.

Being the companion nerve to the main artery, it changes generally its place when the vessel deviates from the usual site. Thus in those instances in which the brachial artery courses along the inner intermuscular septum to the elbow the nerve usually accompanies it; but the nerve may be near the septum without the blood vessel (p. 38). In this last case a wound just above the elbow might cut through the nerve, and interfere with the actions of the parts supplied by it; or from the close contiguity of the ulnar and median nerves, one being before and the other behind the intermuscular septum, C, the same wound dividing both trunks would cause loss of power in the muscles on the front of the limb below the elbow, with insensibility in the fingers and the palm of the hand, and in part in the back of the hand.

The *ulnar nerve* passes through the upper arm without branching, and enters the forearm behind the elbow-joint. As far as the middle of the arm the nerve is close to, and rather

behind the brachial artery ; but it separates afterwards from the vessel, passing through the intermuscular septum, and is continued behind this piece of fascia to the hollow between the olecranon and the inner condyle of the humerus. Pressure applied to it behind the elbow-joint causes a peculiar tingling along the inner side of the hand, and in the inner two fingers.

LYMPHATICS OF THE ARM.

Superficial lymphatics accompany the superficial veins in the arm ; and the greater number lie along the inner part of the limb. Above the elbow are some superficial lymphatic glands in front of the intermuscular septum, which are marked thus, † † † ; these are the lowest superficial glands in the limb. Three glands were present in the dissection. Enlargement of those glands may be brought on by causes which induce inflammation and swelling of lymphatic glands elsewhere ; and a small tumour in this part of the arm may be owing to an increase of one of the glands.

Deep lymphatics with their appertaining glands course with the trunks of the blood vessels beneath the fascia, and enter the glands in the axilla.

DESCRIPTION OF PLATE V.

THIS view exhibits the dissection of the shoulder, and that of the superficial muscles and vessels of the back of the scapula.

On the detached limb this dissection will follow the examination of the subscapularis muscle on the under surface of the scapula ; and it is readily made by reflecting the integuments and the deep fascia from before backwards towards the lower angle of the blade-bone. By cutting through the deltoid near its upper attachment, the vessels and nerve beneath it can be traced out.

MUSCLES OF THE SCAPULA, SHOULDER, AND ARM.

Three groups of muscles are laid bare more or less completely in the dissection, viz., the muscles of two borders of the scapula; those of the posterior surface of that bone; and those of the shoulder and the back of the arm.

All the muscles passing between the humerus and the scapula are relaxed, and are consequently wide and hanging; but in Plate vi. the muscles are shown on the stretch, where the difference in their form and position may be noted.

The dorsal muscles of the scapula cover the shoulder-joint, and will receive injury in dislocation of the head of the humerus.

A. Rhomboideus major.
B. Rhomboideus minor.
C. Levator anguli scapulæ.
D. Teres major.
E. Latissimus dorsi.
F. Long head of the triceps.
G. Outer head of the triceps.

H. Supra-spinatus.
K. Infra-spinatus.
L. Teres minor.
N. Deltoid muscle.
O. Fascia on the dorsal scapular muscles.

The three muscles marked A, B, C, arise from the spinal column, and are fixed into the base of the scapula.

The *rhomboideus major*, A, is inserted between the spine and the lower angle of the bone.

The *rhomboideus minor*, B, is attached opposite the smooth surface at the root of the spine.

The *levator anguli scapulæ*, C, is fixed above the last, reaching from it to the upper angle of the shoulder-blade.

From the direction of their fibres the muscles, when acting without the trapezius, would lower the point of the shoulder, by raising and bringing towards the spinal column the lower angle and base of the scapula.

Connected with the inferior border of the scapula are the teres major and the long head of the triceps; and the latissimus dorsi crosses the others, resting on the inferior angle of the bone.

The *teres major*, D, arises from a special impression on the lower angle of the scapula, from the deep fascia covering the dorsal

scapular muscles, and from the lower edge of the scapula as far forwards as an inch from the long head of the triceps. It bounds the axilla behind, and lies in front of the long head of the triceps (Plates i. and ii.).

The muscle diverges in front from the axillary border of the scapula, leaving a triangular interval between it and the bone; and it is concealed partly by the *latissimus dorsi*, E, when viewed from behind.

The *latissimus dorsi*, E, is attached to the lower part of the trunk of the body by the one end, and to the humerus by the other. Winding over the lower angle of the scapula and the *teres major*, it ascends in front of the *teres* to its insertion into the bicipital groove (Plate ii.).

In the dissection the muscle slipped down somewhat in consequence of its relaxed condition, but its natural place on the angle of the scapula is displayed in Plate vi.

These two muscles could draw the arm to the scapula if the member was at a distance from the trunk; or if the limb was fixed, as in climbing, they would help to approximate the trunk to the raised limb.

And when the *latissimus* has drawn the humerus backwards, it will rotate inwards that bone. If the lower end of the raised humerus is not free to move, this muscle acting with the *teres* and *pectoralis major* draws down the upper end, and may dislodge the head from the articular surface of the scapula.

The dorsal scapular muscles, H, K, and L, cover the shoulder-joint above and behind, and converge to the head of the humerus. A deep fascia covers the muscles, and gives origin to the fleshy fibres: one piece dips between the two *infra-spinous* muscles, K and L, and is fixed to the scapula.

The *supra-spinatus muscle*, H, fills the hollow above the spine of the scapula. Arising from the bone and the fascia, it passes over the shoulder-joint to be inserted into the upper impression on the great tuberosity of the humerus.

The *infra-spinatus muscle*, K, is named from its position below the spine of the scapula. It arises, like the preceding, from the underlying bone and the fascia stretched over it; and, crossing the

shoulder-joint, it is inserted into the middle impression on the great tuberosity of the humerus.

The superficial fibres from the spine of the scapula and the fascia are directed forwards over the fibres coming from the blade part of the bone.

The *teres minor*, L, arises by the side of the infra-spinatus from the fascia, and from a special impression along the axillary border of the scapula. Covering the joint, it is inserted into the lowest mark on the great tuberosity of the head of the humerus, and into the bone below by a few fleshy fibres.

The three muscles above noticed are called "articular" from touching the joint. When in action they cause the humerus to move in the following directions. If the bone is hanging the supra-spinatus will assist the deltoid in raising the arm; and the infra-spinatus and teres minor acting together will draw backwards the point of bone to which they are fixed, becoming external rotators. If the humerus is elevated the two last muscles below the scapular spine will assist the deltoid in carrying backwards the arm almost horizontally.

They suffer more or less injury in dislocations of the shoulder-joint. Should the humerus be dragged downwards from its socket all three may be torn across; or, the muscles remaining whole, a shell of bone, into which they are inserted, may be detached from the humerus. In dislocation backwards the head of the humerus lies under the infra-spinatus, K, and teres minor, L, which are relaxed; and the supra-spinatus is directed backwards, and made tense round the spine of the scapula. But supposing the bone dislocated forwards (on to the other side of the scapula), the infra-spinal muscles will be much stretched if not torn.

The two arm muscles are the deltoid, forming the prominence of the shoulder, and the triceps, which lies behind the arm bone.

The *deltoid muscle*, N, arises from the scapular arch opposite the attachment of the trapezius, viz., from the outer third of the clavicle, and from the acromion and the lower edge of the spine of the scapula as far back as the posterior smooth triangular surface, where it blends with the deep fascia covering the infra-spinous muscles. It narrows below, and is inserted into an impression on

the outside of the humerus above the middle. Sufficient of the muscle has been divided to show beneath it the head of the humerus, the insertion of the dorsal scapular muscles, and the posterior circumflex artery, *a*, and nerve, 1.

Between the acromion process and the deltoid muscle, on the one side, and the head of the humerus with the dorsal scapular muscles on the other, is a bursa—one of the largest in the body—which lubricates those surfaces in the movements of the arm. In chronic rheumatic arthritis, when the surrounding capsule and muscles are destroyed, this bursa communicates with the articulation—the deltoid and acromion becoming incasing structures of the shoulder-joint.

When taking its fixed point above, this muscle is the chief elevator of the humerus, and it can carry backwards and forwards the raised limb; but in all these movements it is assisted by the scapular muscles. The arm is raised by the central fibres of the deltoid and the supra-spinatus muscle, *H*; it is moved forwards by the clavicular fibres and the subscapularis; and it is carried back by the fibres attached to the spine of the scapula, and by the infra-spinatus, *K*, and teres minor, *L*.

Supposing the deltoid to act from the humerus, as in drawing along the body by the arms, the muscle serves as the chief bond of union between the shoulder and arm bones.

Triceps extensor cubiti.—Two heads of this muscle, outer and middle, are visible in the Plate.

The outer head, *G*, attached to the upper part of the back of the humerus, reaches nearly as high as the insertion of the teres minor, *L*, and is covered by the deltoid.

The middle or long head, *F*, is fixed to the inferior costa of the scapula close to the shoulder-joint. This part enters between the two teres muscles (over the major and under the minor), and divides into two the triangular space included by them. In front of the head, between it and the humerus, is a quadrangular interval, through which the posterior circumflex vessels and nerve turn from the axilla; and behind the head is an opening triangular in shape, which transmits the dorsal branch of the subscapular vessels.

A knowledge of the attachments of the muscles to the upper part of the humerus will be serviceable in counteracting in fracture of that bone the displacement of the fragments. In fracture of the neck of the bone near the teres minor insertion the upper end, into which the three dorsal scapular muscles are inserted, will be fixed in the glenoid hollow, and tilted rather outwards. Whilst the lower end will be inclined inwards towards the trunk by the latissimus dorsi, teres major, and pectoralis major, pulling in the direction of their fibres; and it will be finally carried upwards inside the upper fragment by the contraction of the muscles coming from the scapula to the humerus, viz., deltoid, coracobrachialis, and triceps.

In an oblique fracture lower down (about opposite N on the deltoid) the relative position of the fragments to each other would be reversed. In that case the upper fragment will be drawn inwards towards the trunk by the latissimus, teres major, and pectoralis major; but though the lower end of the humerus will be elevated by the muscles descending from the scapula, as before said, it will be placed outside the upper end by the power of the deltoid muscle alone.

ARTERIES OF THE SHOULDER.

The shoulder possesses few vessels in comparison with some other parts. Two small arteries with their veins are met with in this region, and they are derived from the axillary trunk.

The *posterior circumflex artery, a*, one of the lowest branches of the axillary trunk (Plate i. *h*), appears between the humerus and the long head of the triceps; and winding forwards round the shaft of the humerus, it is distributed to the under surface of the deltoid muscle.

It supplies chiefly the deltoid, but offsets enter also the teres minor, and the long head of the triceps. Some branches are given to the head of the humerus, and anastomose in front with the anterior circumflex. A cutaneous offset descends to the integuments over the deltoid.

In the operation of amputation at the shoulder-joint the assistant follows the knife with his hands to seize the large axillary

artery when it is divided, but he cannot compress at the same time the circumflex artery placed much farther back. This vessel pours out blood freely, and it may be secured first, provided the assistant controls the bleeding of the axillary trunk.

The *dorsal scapular artery*, *b*, is an offset of the subscapular branch of the axillary (Plate ii. *f*). Appearing through the triangular space behind the long head of the triceps, it bends round the edge of the scapula under the teres minor, and ramifies in the infra-spinal fossa.

As it is about to enter the fossa a branch is directed along the inferior border of the scapula, between the teres muscles, to which and the integuments it is distributed.

NERVE OF THE SHOULDER.

A large nerve from the brachial plexus ramifies under the deltoid muscle.

The *circumflex nerve*, 1, which is delineated in Plate i. 12, accompanies the posterior circumflex artery to the shoulder. Like the vessel it ends mostly in the deltoid muscle, supplying offsets to the fleshy fibres as it winds over the humerus.

Close to the border of the teres minor a considerable branch, 2, breaks up into offsets to the teres, the back of the deltoid, and the integuments covering the lower part of the deltoid muscle. In the natural position of the integuments the cutaneous branch would wind forwards over the muscle.

On the branch to the teres minor, 3, there is usually an enlargement of a reddish colour and elongated form, which has been designated a "gangliform swelling." Before the nerve is disturbed that swelling lies close to the teres muscle.

In consequence of the loop made by the circumflex nerve under the head of the humerus, compression of it with impairment of function follows dislocation downwards of that bone. Paralysis of the deltoid muscle, with inability to raise the arm, will follow considerable disease or injury of the circumflex nerve.

DESCRIPTION OF PLATE VI.

THE triceps muscle at the back of the arm and some of the shoulder muscles are here displayed. Whilst the Drawing was in progress the body was raised on blocks, and the arm was fastened over the side of the table.

To lay bare the triceps carry an incision along the back of the arm, and reflect the integuments and the deep fascia beyond the elbow. Generally the limb has been separated from the trunk before the student undertakes the dissection; in such case the triceps muscle may be made tense by a block beneath the elbow.

MUSCLES OF THE ARM AND SHOULDER.

On the back of the humerus lies the large triceps muscle, which extends the elbow-joint.

The shoulder muscles have been described with Plate v., and will require but little additional notice; the scapular muscles are more stretched in this than in the preceding Plate.

A. Rhomboideus major.	H. Middle head of the triceps.
B. Latissimus dorsi.	K. Outer head of the triceps.
C. Teres major.	L. Tendon of the triceps.
D. Teres minor.	N. Fascia over the infra-spinatus.
E. Infra-spinatus.	O. Fascia of the arm.
F. Deltoid muscle.	P. Spine of the scapula.
G. Inner head of the triceps.	

The *triceps extensor cubiti* is undivided below, but is split into three processes of origin above, viz., the outer, inner, and middle heads.

The outer head, K, is attached along the upper half of the posterior surface of the humerus, above the groove for the musculo-spiral nerve and its vessels, and reaches upwards nearly to the teres minor (Theile).* This attachment is represented in Plate vii.

* See a foot-note to the description of the triceps belonging to Plate VII.

The inner head, G, larger below than above, and concealed by the middle head, arises from the hinder surface of the humerus below the winding groove, extending laterally to the intermuscular septa, and upwards to the insertion of the *teres major* (Theile). See Plate vii. for its extensive origin.

The middle or long head, H, reaches the inferior or axillary border of the scapula, from which it takes origin for about an inch.

The outer and middle heads blend about the middle of the arm, but the inner one joins lower down. The muscle ends below in a wide, strong tendon, which receives deep fleshy fibres down to the elbow joint, and is inserted into the end of the olecranon process of the ulna—a small bursa lying between the tendon and the tip of that piece of bone.

This muscle is represented in the thigh by the extensor muscle of the knee-joint. It is subcutaneous except above; and it is separated laterally from the muscles in front of the humerus by processes of fascia—the intermuscular septa. The long head lies between the *teres* muscles.

By the action of this muscle the elbow-joint will be extended; and supposing the limb removed from the body, it can be approximated to the trunk by the long head. But should the upper limb be fixed at a distance from the side, the muscle can assist in moving the trunk (through the scapula) towards the fixed arm, as in dragging the body forwards by a rope.

When the olecranon process of the ulna is detached by fracture, it is drawn upwards by the *triceps*, as far as the lower fleshy fibres of the muscle will allow, in the same manner as the upper fragment of the patella, in transverse fracture of that bone, is carried upwards by the *extensor cruris*. When replacing the displaced fragment force is not to be employed alone for the purpose of drawing it down towards the end of the ulna; but the interval is also to be diminished by moving backwards the shaft of the ulna by the extension of the elbow-joint.

In dislocation forwards of the humerus the olecranon becomes very prominent behind the elbow, and the tendon of the *extensor* muscle stands out from that bone something like the tendo

Achillis in the leg. Also some of the lower fleshy fibres will be broken through by the humerus being forced from the tendon.

By the action of the triceps, fracture of the lower end of the humerus near the elbow may be made to resemble the dislocation above noticed; for the lower end of the bone entering into the elbow-joint is forced upwards behind the rest of the shaft by the contracting muscle, and the olecranon is rendered more than usually prominent. But the nature of the injury may be made out by attention to the place of the olecranon:—in a dislocation this point of bone projects much beyond, and is higher than the condyles of the humerus; but in fracture of the bone it is not more prominent with respect to the condyles than in the other limb, and it retains its usual position on a level with them.

Deltoid muscle, F.—At the origin of this muscle from the spine of the scapula it is tendinous behind, and blends with the fascia covering the infra-spinate muscle. The hinder part of the muscle has been turned forwards to allow a sight of the circumflex vessels and nerve beneath.

Latissimus dorsi, B.—The muscle has been cut and thrown down as it crosses the angle of the scapula; the extent to which it covers that point of bone, and the rhomboideus major and teres major muscles, may be observed.

ARTERIES OF THE ARM AND SHOULDER.

The trunk of the brachial artery and some of its offsets are met with in the dissection of the back of the arm. Branches of the axillary artery are distributed to the shoulder.

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|---|--|---|
| <i>a.</i> Dorsal scapular artery.
<i>b.</i> Circumflex artery.
<i>c.</i> Muscular offset of the superior profunda artery. | | <i>d.</i> Muscular branch of the brachial.
<i>e.</i> Trunk of the brachial.
<i>f.</i> Muscular branch of the brachial.
<i>g.</i> Inferior profunda artery. |
|---|--|---|

The *brachial artery*, *e*, is visible from behind where it lies inside the humerus, but it disappears below by passing in front of the arm bone. Contiguous to the upper part of the artery is the triceps muscle, viz., the middle head, H, and the inner head, G.

A large companion vein (the continuation of the basilic) is placed on the inner side.

Close inside the artery is the ulnar nerve, 3; and intervening between it and the middle head of the triceps is the musculo-spiral nerve, 4.

Two *muscular offsets*, *d* and *f*, enter the long head of the triceps.

The *upper profunda*, or the muscular artery of the back of the arm, is concealed by the middle head of the triceps; an offset, *c*, from it enters the outer head of that muscle. The distribution of this branch is represented in Plate vii.

Inferior profunda artery, g.—Winding backwards from the brachial (Plate iv.), it accompanies the ulnar nerve, 3, to the interval between the olecranon and the inner condyle, where it joins a branch of the ulnar artery.

The *dorsal scapular artery, a*, courses under the teres minor muscle, p. 58. Amongst the surrounding muscles supplied by it is the deltoid, to which it gives an offset: this was cut through in the dissection.

The position of the *posterior circumflex artery, b*, to the deltoid appears in this view of the parts. Some of its muscular offsets, and the branch to the integuments, are apparent.

NERVES OF THE SHOULDER AND ARM.

The nerves of the shoulder and back of the arm are branches of the brachial plexus, and have been partly represented in other Illustrations.

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|--|--|--------------------------|
| 1. Circumflex nerve. | | 3. Ulnar nerve. |
| 2. Offset of the musculo-spiral to the middle head of the triceps. | | 4. Musculo-spiral nerve. |

Circumflex nerve, 1.—The anatomy of the trunk of the nerve can be studied in Plate v. Its cutaneous offset retains its natural place in this dissection.

The *musculo-spiral nerve, 4*, winds from the inner to the outer side of the limb between the humerus and the triceps muscle

(Plate vii.) The figure, 2, marks an offset from it to the middle head of the triceps.

The *ulnar nerve*, 3, lies along the inner side of the arm as far as the elbow (Plate iv.). In the lower half of its course it is placed at the back of the limb, behind the inner intermuscular septum, and is partly concealed by fibres of the inner head of the triceps.

In excision of the articular ends of the bones of the elbow-joint through the triceps, the ulnar nerve is liable to be cut. To secure it from accident the nerve is dislodged from its hollow during the operation, and is moved to the front of the projecting inner condyle of the humerus. Temporary loss of the power of contraction in the muscles, and of feeling in the integuments of the inner part of the forearm and hand, follows division of the nerve; and this lost power would not be regained till the nerve structure has been repaired.

DESCRIPTION OF PLATE VII.

DISSECTION of the musculo-spiral nerve at the back of the arm, with its accompanying artery—the profunda.

Supposing the triceps denuded, as in Plate vi., the middle and outer heads are to be cut through after the manner shown in the Figure, to trace the nerve and its vessels. At the outer part of the muscle, a small branch of nerve and artery should be followed through the fleshy fibres to the anconeus muscle of the forearm.

MUSCLES OF THE ARM AND SHOULDER.

After the triceps has been divided in the way indicated, the attachment of the inner and outer heads to the humerus becomes evident.

The shoulder muscles have been displaced but little during the dissection, but they are shown on the stretch in consequence of the limb being placed in a hanging posture.

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|---|-------------------------------------|
| A. Lower end of the long head of the triceps cut through. | H. Supinator longus muscle. |
| B. Upper end of the long head of the triceps. | K. Teres minor muscle. |
| C. Outer head of the triceps. | L. Infra-spinatus muscle. |
| D. F. Inner head of the triceps. | M. Latissimus dorsi muscle. |
| E. The nerve and vessels to the anconeus. | N. Teres major muscle. |
| G. Anconeus muscle. | P. Deltoid muscle. |
| | Q. Outer condyle of the humerus. |
| | R. Olecranon process. |
| | S. Fascia of the forearm reflected. |

Triceps extensor brachii.—The superficial view of this muscle, and the attachment of the middle head can be seen in Plate vi. Only the origin of the outer and inner heads will be noticed below.

The outer head, C, arises at the back of the humerus above the groove in the bone, which lodges the musculo-spiral nerve and the vessels; it narrows above as it ends near the insertion of the teres minor. *NB. origin linear & chiefly tend.*

The inner head, D, and F, arises from the back of the humerus below the winding groove, reaching upwards by a pointed part as high as the teres major muscle—sometimes to the upper, and sometimes the lower border. This head is wide below, and reaches laterally to the intermuscular septa, from which fibres take origin.*

Subanconeus.—Some of the deepest fibres of the triceps near the elbow terminate in the capsule of the joint, like fibres of the extensor of the knee, and are said to constitute a separate muscle, to which the name subanconeus has been applied; but I have not observed such isolated and distinct muscular bands as Anatomists describe.

Supinator longus muscle, H.—Covered by the fascia of the limb the muscle is fixed to the outer condyloid ridge of the humerus, as high as the groove before referred to. This muscle and the extensor carpi radialis longus occupy the ridge—the former reach-

* This statement of the origin of the inner and outer heads of the triceps differs much from the common Anatomical description. It contains the view of Theile, and has the merit of being more accurate. The original account is given in Müller's *Archiv für Anatomie, &c.*, for 1839, p. 420—"Ueber den Triceps brachii und den flexor digitorum sublimis des Menschen."

ing the upper two thirds, and the latter, the lower third. Above the upper border of the supinator the musculo-spiral nerve and vessels are directed forwards.

The group of shoulder muscles is strained by the weight of the arm, as in Plate vi.

Naturally the *teres minor muscle*, K, is not so covered by the long head of the triceps; but as this head was cut, and the limb hanging, its upper end, B, was pushed back by the latissimus dorsi arching in front.

The *latissimus dorsi*, M, and *teres major*, N, are stretched as they descend to the humerus. Only the upper edge of the *teres* appears; below and in front they are partly blended by tendinous fibres.

By the weight of the limb the *deltoid muscle*, P, is made to look flatter than it is usually.

VESSELS OF THE BACK OF THE ARM.

The ramifications of the superior profunda artery through the triceps, and its origin from the brachial trunk, are contained in this region. Some small branches of the circumflex artery appear behind the border of the deltoid.

- | | |
|---|---|
| <p>a. Brachial artery.</p> <p>b. Basilic vein becoming axillary.</p> <p>c. Superior profunda artery.</p> <p>d. Offset of the profunda to the front of the arm, with the musculo-spiral nerve.</p> <p>f. Branch of artery along the outer intermuscular septum.</p> <p>g. Inosculating artery from the recurrent radial.</p> | <p>h. Anastomotic branch from the post interosseous recurrent artery.</p> <p>k. Muscular branch of the artery to the triceps and anconeus.</p> <p>l. Branch of artery to the <i>teres minor</i> from the posterior circumflex.</p> <p>m. and n. Cutaneous and muscular offsets of the posterior circumflex artery.</p> |
|---|---|

Brachial artery, a.—The anatomy of the brachial trunk issuing from the armpit has been described with Plate vi. p. 61. The following large muscular offset springs from this part of the artery.

The *superior profunda* branch, c, is the nutritive and anasto-

motie vessel of the back of the arm, and corresponds with the profunda artery of the femoral trunk in the thigh. Springing from the brachial, near the axilla, it is the largest offset of that vessel, and winds behind the humerus in the hollow separating the inner and outer heads of the triceps, as far as the outer side of the limb, where it ends in muscular, anastomotic, and cutaneous offsets.

The *muscular branches* supply the three heads of the triceps, viz., the long head, A, the external, C, and the internal, D. A second artery enters the long head from the brachial trunk.

The *anastomotic offsets*, three in number, spring from the end of the profunda. One, *d*, variable in size, accompanies the musculospiral nerve to the front of the arm, and communicates with the radial recurrent. A second, *f*, runs on the intermuscular septum to the outer condyle, and anastomoses with a branch, *g*, of the radial recurrent, and with a branch, *h*, of the recurrent interosseous; and the third artery, *k*, descends in the triceps to the hollow between the outer condyle and the olecranon, and entering the anconeus, G, joins in the last muscle with the recurrent of the interosseous.

The *cutaneous offsets*, two or three in number, pass out with nerves to the integuments, and are derived, for the most part, from the branch, *f*.

The *posterior circumflex artery* enters under the deltoid muscle (Plate v.). From the part of the artery now visible spring the branch to the teres minor, *l*, and the offsets to the integuments and the deltoid, *m*, and *n*.

The usual *companion veins* run with the arteries, though they are not included in the Plate; those with the profunda artery join a brachial vein; and the circumflex veins open into the axillary trunk.

NERVES OF THE BACK OF THE ARM.

The nerves correspond in the main with the vessels. With the profunda is situate the large musculospiral nerve, distributing branches to the triceps and the integuments; and by the side of

the circumflex artery lies the muscular nerve of the same name, which ends in the deltoid.

- | | |
|--|--|
| <p>1. Musculo-spiral nerve.</p> <p>2, 2. Ulnar nerve.</p> <p>3. Offset to the long head of the triceps.</p> <p>4. Offset to the inner head of the triceps.</p> <p>+++ Three branches to the outer head of the triceps.</p> | <p>6. Branch to the anconeus.</p> <p>7. Upper external cutaneous of the musculo-spiral.</p> <p>8. Lower external cutaneous of the musculo-spiral.</p> <p>9. Nerve to the teres minor.</p> <p>10. Cutaneous branch of the circumflex nerve.</p> |
|--|--|

The *musculo-spiral nerve*, 1, begins in the brachial plexus (Plate i. 13); and, reaching the digits, supplies the extensor and supinator muscles on the back of the arm and forearm, together with some of the integuments.

In the arm the trunk winds behind the humerus from the inner to the outer side, and divides at the outer condyle into two—radial and posterior interosseous nerves (Plate xii.). The nerve lies in the groove of the humerus between the inner and outer heads of the triceps, and turns to the front of the arm above the supinator longus muscle, H. Offsets of the part of the nerve now dissected supply the extensors of the elbow-joint and the teguments.

Muscular branches enter the heads of the triceps. One, 3, belongs to the parts, A, and B, of the long head; others, 4, and 6, supply the inner head, D; and three † † † enter the outer head, C. To the inner and long heads some branches are furnished by the trunk of the nerve in the axilla (Plate iv. 2).

The branch, 6, of the anconeus is very slender, and is contained in the triceps.

Cutaneous nerves.—Two external cutaneous appear with superficial arteries on the outside of the limb; the upper one, 7, smaller than the other, reaches in the integuments of the arm as far as the elbow; and the lower nerve, 8, is continued beyond the elbow, on the back of the forearm, nearly to the wrist.

Whilst the musculo-spiral is contained in the axilla it furnishes an internal cutaneous nerve to the inner and hinder parts of the arm (Plate iv. 1).

If the musculo-spiral nerve is cut across, or its action much im-

paired by disease, the extensor muscles of the elbow-joint, amongst others, would be incapable of contracting ; and the elbow would therefore be bent by the flexors which, being uncontrolled by their antagonists, would carry forwards the forearm bones.

Ulnar nerve, 2, 2.—The upper and lower parts of this nerve come into view in the Figure. The whole course of the nerve appears in Plate iv.

Circumflex nerve of the shoulder.—The trunk of the nerve is noticed in the description of Plate v. Two offsets, viz., one marked, 9, for the teres muscle, and another, 10, for the integuments, appear behind the deltoid muscle.

DESCRIPTION OF PLATE VIII.

THE dissection of the muscles, vessels, and nerves of the front of the forearm, with their connections undisturbed by the reflection of the deep fascia, is here displayed.

All the superficial coverings of the limb may be removed at once by an incision along the front of the forearm, met by a cross-cut a little above the elbow, and by another rather below the wrist. But a more profitable dissection may be made by examining, and afterwards removing in successive layers, the skin, the subcutaneous fat with its vessels and nerves, and the deep fascia.

SUPERFICIAL MUSCLES OF THE FOREARM.

Inside the line of the brachial and radial arteries, *b* and *f*, lies a group of muscles which act as flexors and pronators ; and outside the vessels is a mass of muscles consisting of extensors and supinators, antagonists of the former set.

The inner group is divided into two strata, superficial and deep. Five muscles belong to the superficial layer : of these one is a

pronator of the hand, and the others are flexors of the wrist and fingers.

A. Biceps flexor brachii.
 B. Brachialis anticus.
 C. Pronator teres.
 D. Palmaris longus.
 E. Flexor carpi radialis.
 F. Flexor digitorum sublimis.
 G. Flexor carpi ulnaris.
 H. Flexor longus pollicis.
 L. Supinator longus.
 N. Palmaris brevis.

P. Extensor carpi radialis longior.
 S. Extensor ossis metacarpi pollicis ; close alongside is the tendon of the extensor primi internodii pollicis.
 † Inner intermuscular septum of the arm.
 * Slip of fascia connecting the tendon of the flexor carpi ulnaris with the annular ligament.

Pronator radii teres, C, the first muscle of the inner group, arises in part from the common origin ;* from the condyloid ridge of the humerus ; and from the coronoid process of the ulna by a separate slip (Plate ix.). Below it is inserted into the middle of the radius beneath the supinator longus, L.

By its outer edge the muscle bounds the hollow in front of the elbow, and by the other it touches the flexor carpi radialis. Near the insertion the radial vessels rest on it.

When the pronator first contracts it will roll the radius over the ulna, pronating the hand ; and acting still more, it will bend the elbow-joint over which it passes.

The *flexor carpi radialis*, E, having the common origin, is continued through a groove in the os trapezium to be inserted chiefly into the base of the metacarpal bone of the index finger, but also by a slip into the metacarpal bone of the middle finger.

The tendon of the muscle is prominent below outside the middle line of the forearm, and bounds internally a surface-depression over the radius which contains the radial artery ; it may be taken as the guide to that vessel.

After bending the wrist, the muscle will approximate the forearm to the arm.

* Most of the superficial muscles of the forearm, on both the front and back, have a common origin from the fascia of the limb, and from a strong fibrous process (tendon of origin) which is attached to the condyle of the humerus in each case, and sends pieces between the muscles.

The *palmaris longus*, D, has the common origin between the preceding and the flexor carpi ulnaris, G; and its tendon piercing the aponeurosis of the limb near the wrist, ends in the fascia of the palm of the hand, after sending a slip to join the short muscles of the thumb. This muscle may be absent.

It renders tense the palmar fascia, and assists in bending the elbow and wrist.

The *flexor carpi ulnaris*, G, is the most internal muscle of the set. Attached to the inner condyle of the humerus, where it blends with the other muscles, and to the posterior ridge of the ulna by an aponeurosis, it is inserted into the pisiform bone, and joins by offsets the annular ligament of the wrist and the muscles of the little finger.

The outer edge of the muscle corresponds with a line from the pisiform bone to the inner condyle of the humerus, and there is a surface-groove in the lower third of the forearm over that edge. The muscle conceals below the ulnar vessels and nerve.

Its main action is expressed by its name, but it serves also as a flexor of the elbow-joint.

The *flexor digitorum sublimis*, F, is the deepest of the muscles of the superficial layer. It is attached by its thin outer edge to the upper three fourths of the shaft of the radius; higher still, to the inner side of the coronoid process of the ulna; and finally to the lateral ligament of the elbow-joint, and the common tendon of origin of the other muscles. It ends below in four tendons for the fingers, which cross the hand, and are inserted into the middle phalanges (Plate x.).

The extent of attachment to the radius, and the position of the radial vessels to it may be noticed in the Drawing. Only two tendons appear on the surface, viz., those of the middle and ring fingers. Issuing beneath the lower border is the median nerve, 2.

Besides bending the phalanges, the muscle will contribute to flex the wrist and elbow.

Above the elbow are the flexors of that joint, viz., *biceps* and *brachialis anticus*. The first is inserted into the radius and the

other into the ulna ; and when they contract they carry forwards those bones over the end of the humerus.

After fracture of the olecranon process of the ulna—the part limiting the movements and giving security to the joint—the elbow is bent because these two muscles are stronger than the extensor muscles behind (the triceps being useless).

In dislocation of the humerus on the front of the ulna and radius, the flexor muscles give the bent state to the limb. Being greatly stretched, especially the brachialis, by the large projecting end of the humerus, they contract powerfully ; and the forearm is carried forwards as much as it can be to relax the tense state of the muscular fibres.

The extensors and supinators on the outer side of the limb are dissected only in part : they will be described more fully with Plate xii. They are divisible, like the muscles in front, into a superficial and a deep layer. Only one of them will be referred to now.

The *supinator longus*, L, (brachio-radialis Scem.), is the most anterior and the longest of the external group. It arises from the upper two thirds of the condyloid ridge of the humerus in front of the outer intermuscular septum (Plate xii.) ; and it is inserted into the lower end of the radius, close to the styloid process.

Covered at its origin and insertion by other muscles, it forms part of the outer swell of the forearm, and limits externally the hollow in front of the elbow-joint. It rests upon the long radial extensor of the wrist, P, and covers the radial artery in the upper half of the forearm. At its insertion it is crossed by the extensor muscles of the thumb, S.

Its chief office is to bend the elbow-joint. But it will become a supinator when the hand is quite prone ; and, when the hand is strongly supinated, it is said to bring the same into the prone position.

HOLLOW IN FRONT OF THE ELBOW.

This intermuscular space between the inner and outer groups of

muscles is represented in the lower limb by the ham. It contains the chief vessel of the arm and the companion nerve; and by its position on the aspect of the limb to which the joint is bent, greater freedom of movement forwards is permitted.

The interval is somewhat triangular in form, as seen on the surface, and has the following boundaries:—stretching over it is the aponeurosis of the limb joined by an offset from the biceps tendon, with the integuments and the superficial veins and nerves (Plate iii.); and covering the underlying bones are the brachialis anticus, B, and supinator brevis. Externally is placed the supinator longus, L, and internally the pronator teres, C; the fibres of the former being nearly straight in the forearm, and those of the latter slanting downwards and outwards. The base is turned towards the arm; and the apex points forwards in the forearm.

Contained in the hollow is the tendon of the biceps, with vessels, nerves, fat, and lymphatics; and their position in it is as follows:—

On the outer side is the biceps muscle, A, whose tendon dips into the space to reach its insertion into the radius.

The brachial artery, *b*, lies close inside the biceps, and divides, opposite the “neck of the radius” (Quain), into the two arteries of the forearm, which are directed forwards through the space, the radial being superficial and the ulnar deep in its position. Venæ comites entwine around the arterial trunks. Small arteries are found in the space. Thus in the outer part the recurrent of the radial artery (Plate xii. 3) is directed transversely to the supinator longus; and in the inner part of the hollow, offsets of the anastomotic artery, *a*, descend beneath the pronator teres to join the anterior recurrent of the ulnar artery. Other cutaneous offsets, *c* and *d*, come forwards to the integuments from the brachial and the radial artery.

Inside the artery, and separated from it by a slight interval, which increases below to a quarter or half an inch, comes the median nerve, 2. At this spot the nerve supplies small offsets to the inner group of muscles of the forearm. Underneath the supinator longus, and therefore outside the superficial limits of

the space, the musculo-spiral nerve may be found dividing in front of the condyle of the humerus into radial and posterior interosseous branches.

Loose fat fills the hollow, supporting the vessels and nerves, and extends into the forearm along the bloodvessels; and blood effused beneath the fascia finds its way along the same channels. re

A few lymphatic glands with their connecting vessels accompany the arteries—two or three lying on the sides of the brachial, and one below its point of splitting.

From the lax condition of the parts surrounding the brachial artery pressure applied to the vessel, when wounded, should be firm and graduated. The limb too should be kept still; for when the elbow is moved much the vessel may slip away from the compressing pad, and blood may be effused beneath the fascia.

ARTERIES OF THE FOREARM.

Two chief vessels occupy the front of the forearm, and these spring from the division of the brachial trunk. They are named radial and ulnar from their position in the limb; and both reach the palm of the hand, where they form arches and supply branches to the fingers. Both are placed deeper near the elbow than at the wrist.

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|---|--|
| <p><i>a.</i> Anastomotic branch of the brachial trunk.</p> <p><i>b.</i> End of the brachial artery.</p> <p><i>c, d.</i> Unnamed cutaneous offsets: the former from the brachial, and the latter from the radial artery.</p> | <p><i>f.</i> Radial artery.</p> <p><i>g.</i> Superficial volar branch.</p> <p><i>h.</i> Ulnar artery.</p> <p><i>n.</i> Cutaneous median vein, joining a deep companion vein.</p> |
|---|--|

The *radial artery*, *f*, is the more external of the two bloodvessels in the forearm, and inclines from the bifurcation of the brachial trunk to the lower end of the radius; it then winds to the back of the wrist below the radius, and enters the hand. The part from the wrist onwards will be included in other dissections (Plates x. and xi.). A line from the centre of the elbow-joint

to the styloid process of the radius will mark the course of the vessel on the front of the forearm.

In the *upper half* of the forearm the artery is concealed by the supinator longus;* and it rests in succession on the supinator brevis, pronator teres, C, and flexor sublimis digitorum, F.

Venæ comites lie on the sides of the artery. But no nerve is in contact with it—the radial being placed too far out.

This part of the artery may be superficial to the long supinator, lying even in the integuments, when there is an unusual origin from the brachial.

In the *lower half* of the forearm the vessel is not covered by muscle, but is contained in a hollow between the tendons of the flexor carpi radialis, E, and supinator longus, L. Only the common teguments cover the vessel here. It is supported by part of the flexor sublimis, F, flexor longus pollicis, H, and lower down by the pronator quadratus and the end of the radius.

The usual veins surround the artery. The radial nerve, 3, is at some little distance outside the vessel, and becomes cutaneous behind the tendon of the supinator longus.

The *offsets* of the radial artery are for the most part small, but near the elbow and wrist they acquire greater size. No one is large enough usually to interfere with the placing a ligature on the trunk.

Ligature of the radial artery.—In the upper half the vessel would not require to be tied in the living body unless it was wounded. In seeking it amongst the tissues infiltrated with blood the supinator longus, and the line of the vessel, will serve as material aids to the surgeon.

In the lower third of the forearm, the radial may be secured for a wound in the palm of the hand. With a cut about one inch and a half long the integuments and superficial veins and nerves are to be divided in the line of the vessel. The fascia may be

* In Anatomical Plates the radial artery is usually delineated with the supinator longus removed from it, as if the vessel was uncovered by muscle in the upper half of the forearm. In this Plate the muscle is shown covering the artery, as it exists before it is displaced, to impress upon the memory the fact that where the radial is so protected it cannot be easily injured.

carefully cut for the same extent. After the sheath has been opened and separated from its contents in the usual way, the aneurism needle may be carried round the artery.

As this part of the radial is so superficial the student, when first practising the operation, cuts oftentimes, not only the coverings of the limb, but also the artery.

If the vessel is tied for a wound near the wrist two ligatures should be applied, although the size is so small, on account of the free communication of the radial with the ulnar artery in the palm of the hand.

Branches of the artery.—Small unnamed muscular and cutaneous offsets leave the trunk of the artery at intervals; and larger named branches arise near the beginning and ending.

The *recurrent radial* ascends under cover of the supinator longus, and anastomoses on the outer part of the elbow with the superior profunda (Plate xii.): it supplies some of the outer group of muscles.

The *superficial volar branch, g*, descends to the hand across or through the short muscles of the thumb. When small, it ends in those muscles (Quain); and when larger, it joins the superficial palmar arch (Plate x.). With this vessel of very unusual size a wound of it might require it to be tied.

The *anterior carpal branch* (Plate ix. *d*), which is generally so small as not to deserve notice, arises near the wrist, and is lost on the carpus.

Muscular and cutaneous branches arise at tolerably regular intervals. One to the integuments is marked by *c*. From a muscular branch near the wrist a twig entered the median nerve.

The *ulnar artery, h*, is concealed almost entirely by muscles whilst it is in the forearm, only a small part near the wrist being visible before the natural position of the flexor carpi ulnaris has been disturbed.* And the part of the artery, which is repre-

* In Plates of the vessels of the forearm, where the ulnar artery is laid bare to view in the lower third or more, the flexor carpi ulnaris has been drawn aside in the dissection. This rather deep condition of the artery should be kept in mind in any attempt to put a ligature on it.

sented, appears smaller than it is commonly, in consequence of being partly covered by the *venæ comites*. The course and the branches of the artery are shown in Plate ix.

NERVES OF THE FOREARM.

Three nerves, viz., median, ulnar, and radial, are visible each for a short distance in this dissection of the superficial muscles of the forearm.

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| 1. Cutaneous part of the musculo-cutaneous, named external cutaneous of the forearm. | 3. Radial nerve. |
| 2, 2. Median nerve. | 4. Cutaneous palmar branch of the median nerve. |
| | 5. Palmar part of the ulnar nerve. |

The *median nerve*, 2, is superficial for two inches above the wrist, and is placed on the outer side of the tendons of the flexor sublimis. As it passes through the forearm it lies beneath the superficial flexors. From the forearm it is continued to the hand beneath the annular ligament. The following offset arises from this part of the nerve.

The *cutaneous palmar branch*, 4, pierces the deep fascia near the wrist, and crosses over the annular ligament to end in the integuments of the ball of the thumb and palm of the hand; at its ending it communicates with the ulnar nerve.

The *radial nerve*, 3, is a tegumentary branch of the musculospiral (Plate xii. 2), and ends on the back of the hand. Becoming superficial behind the tendon of the supinator longus, it terminates in the teguments of the back of the thumb, of the next two digits, and sometimes of half the ring finger.

The *ulnar nerve*, 5, enters the palm of the hand over the annular ligament; its termination is given in Plate x. This is the only part of the nerve which comes into sight in the forearm before the flexor carpi ulnaris has been turned aside; and it is partly concealed by the ulnar vessels.

DESCRIPTION OF PLATE IX.

THIS Plate represents the dissection of the deep muscles on the front of the forearm, with the vessels and nerves in contact with them.

To make ready the dissection cut through near the humerus and remove the inner group of the superficial muscles, seen in Plate viii., except the pronator teres on the outside, and the flexor carpi ulnaris on the inside; then draw upwards the pronator, and inwards slightly the flexor ulnaris from the ulnar vessels. The small veins with the branches of the arteries have been taken away.

DEEP MUSCLES OF THE FOREARM.

The deep muscles are three in number: two flex the digits, and one pronates the radius. One, a flexor of the thumb, lies on the radius; and the other large muscle, covering the ulna, is the common flexor of the fingers. The pronator is placed beneath the other two near the wrist.

- A. Lower end of the biceps.
- B. Brachialis anticus.
- C. Supinator longus.
- D. Pronator teres.
- F. Conjoined palmaris longus and flexor carpi radialis, cut, and turned aside.
- G. Flexor carpi ulnaris.
- H. Supinator brevis.
- J. Cut end of the flexor sublimis.
- K. Flexor longus pollicis.

- L. Flexor profundus digitorum.
- N. Slip of flexor longus pollicis.
- O. Extensor ossis metacarpi pollicis.
- P. Pronator quadratus muscle.
- Q. Tendons of flexor sublimis, cut.
- R. Tendon of flexor carpi radialis.
- X. Anterior annular ligament.
- † Internal intermuscular septum of the arm.

The *flexor longus pollicis*, K, arises from the upper three fourths of the anterior surface of the shaft of the radius; from the con-

tigious interosseous membrane ; and sometimes by a round slip, N, from the inner part of the coronoid process of the ulna. Its tendon passes beneath the annular ligament, X, and is conveyed along the thumb by a fibrous sheath to be inserted into the last phalanx.

Most of the muscle is covered by the flexor sublimis, but part of it below is in contact with the radial artery where the pulse is felt. Between the upper attachments of this muscle and the supinator brevis, H, to the radius, is a narrow slip of the bone from which the flexor sublimis digitorum arises.

The muscle bends the phalanges of the thumb, and brings the metacarpal bone towards the palm of the hand. It will flex the wrist after the digit.

Flexor profundus digitorum, L (perforans). It arises from the anterior and inner surfaces of the shaft of the ulna as low as the pronator quadratus ; and other fibres spring from the membranes outside and inside the bony attachment, viz., from the interosseous membrane externally, and from an aponeurosis common to this muscle and the flexor carpi ulnaris internally. The fleshy fibres end in tendons which are united together above the wrist, only the most external being separate ; and these, passing beneath the annular ligament, X, and across the hand, are inserted into the last phalanges of the fingers. See Plate x.

On the sides of the muscle are the flexor longus pollicis, K, and flexor carpi ulnaris, G. On it rest the ulnar vessels, and the ulnar and median nerves.

This muscle bends the last phalanx of each finger ; and continuing its action it will aid in flexing the other phalanges and the wrist.

The *pronator quadratus*, P, lies beneath the preceding, and covers the lower ends of the bones of the forearm for about two inches, though more of the ulna than of the radius. Scarcely any part of the muscle is seen, but the interosseous nerve and artery pass beneath its upper edge, marking its extent upwards.

It is covered by the other two muscles of the deep layer, and the radial vessels touch the outer edge, near the wrist.

It acts on the radius, moving the lower end round the ulna so as to put down the palm of the hand.

Movement of the radius.—The rotatory motion of the hand is due to the movement forwards and backwards of the lower end of the radius over the ulna. When that bone is brought forwards the palm of the hand is placed down, or the limb is pronated; and when the bone is moved back the dorsum of the hand is turned towards the ground, and the member is supinated. The pronator muscles are in front, and passing from the inner side of the limb, draw forwards the radius; while the supinators, which turn back the bone, are placed on both the front and hinder part of the limb. The action of the supinators will be given with the description of Plate xii.

Two pronators are connected with the radius;—one, pronator teres of the superficial layer, being attached about midway between the ends; and the other, pronator quadratus, of the deep layer, is fixed into the lower part. Both are therefore inserted below the upper half of the bone; and during their contraction the lower end of the radius is moved over the ulna—the upper end not changing its position to that bone, but rotating in its band like a wheel. And as the active supinators (supinator brevis and biceps) are fixed to the upper part of the radius, their influence on the lower end is neutralised as soon as the bone is broken through at or near the middle; so that the lower fragment can be then moved forwards without obstacle by the action of the pronators.

Fracture of the radius near or below the middle is attended by pronation of the hand, and by displacement of the lower fragment, in consequence of the action of one or both of the pronators, and of the weight of the hand articulated to the radius. But the upper fragment of the broken bone does not change its place; it remains on the outer side of the ulna, though tilted away from that bone by the action of the supinators. Readjustment of the displaced lower fragment will be made by supinating the hand, for this movement carries back at the same time the lower end of the broken radius into contact with the upper. Future displacement of the lower fragment will be prevented if the

weight of the hand is taken off by fixing the forearm and hand with splints in a position midway between pronation and supination, so that the thumb shall be in a line with the upper part of the radius, and the palm of the hand shall be turned to the chest.

Should the lower fragment not be brought well into line with the upper by the position of the forearm above-said, it will be necessary to place the hand quite supine (the palm of the hand looking directly upwards), and to fix it with splints in that posture, as was recommended by Mr. Lonsdale.*

In *fracture of the shafts of both bones* of the forearm, the lower ends, as in fracture of the radius, depart from the line of the upper ends, being dragged away by the weight of the hand. They have further a tendency to approximate across the interosseous space, and will therefore be easily made to touch by any constriction, such as a bandage round the limb.

By supinating the hand in the manner described for fracture of the radius, the lower displaced ends will be brought to the upper fixed parts of the bones. And with the view of keeping apart the bones, gentle pressure with a narrow graduated pad is sometimes employed along the front and back of the forearm in a line with the interval between them. Pressure by means of a bandage is not to be made on the member, lest the broken ends be brought together, and the movements of the radius be lost by this bone blending with the ulna in the process of union. Redisplacement of the apposed ends may be prevented by splints reaching from the elbow to the fingers.

ARTERIES OF THE FOREARM.

Both radial and ulnar arteries are laid bare in the dissection, but the anatomy only of the ulnar and its branches will be now given. For a short distance above the elbow-joint the brachial trunk is shown.

* "Fracture of the Forearm." By Edward Lonsdale. *Medical Gazette*, 1832, p. 910.

a. Brachial artery.	e. Superficial volar branch.
b. Radial artery.	g. Posterior ulnar recurrent branch.
c. Ulnar artery.	k. Anterior interosseous.
d. Anterior carpal branch of the radial trunk.	n. Median artery.

The *ulnar artery*, *c*, tends to the inner side of the limb, and enters the palm of the hand in front (Plate x.). It keeps the name "ulnar" from the bifurcation of the brachial trunk to the lower border of the annular ligament, X.

The artery has a curved course in the forearm, being directed inwards in the upper part, but taking a straight direction at the lower part. A line on the surface, to mark the straight part of the artery, should be drawn from the inner condyle of the humerus to the inner side of the pisiform bone. The vessel is covered by muscles in the upper half of the forearm, but becomes more superficial below.

In the *deep part* of its course, viz., between the origin and the meeting with the flexor carpi ulnaris, G, the artery is curved with the convexity upwards. It is covered by the superficial layer of muscles except the flexor carpi ulnaris; and it rests firstly on the lower part of the brachialis anticus, B, and afterwards on the flexor profundus digitorum, L.

Companion veins are ranged on its sides, with communicating branches over it.

The median nerve, 1, is placed inside the ulnar artery for about an inch; it then crosses over, and leaves that vessel in the forearm. The ulnar nerve, 3, approaches the artery about half way between the wrist and elbow-joints, from which point it is situate inside, and close to the vessel.

The *lower half* of the artery lies along the flexor carpi ulnaris, G, by which it is overlapped (Plate viii.); and it is therefore more deeply placed than the corresponding part of the radial blood-vessel. On its outer side are the tendons of the flexor sublimis digitorum, F (Plate viii.), and it lies on the flexor digitorum profundus, L.

The companion veins join together freely over the artery, and the ulnar nerve, 3, is in contact with it on the inner side.

Filaments of the palmar cutaneous branch, 6, of the ulnar nerve entwine around the vessel.

As the artery rests on the annular ligament of the wrist, it is very near the pisiform bone; it is crossed by a slip from the flexor carpi ulnaris to the annular ligament, and is concealed by some fleshy bundles of the palmaris brevis muscle (Plate viii.). The nerve, still internal, intervenes between the bone and the blood-vessel.

All the offsets of the lower part are too small to be considered of moment in ligature of the artery.

Ligature of the artery at its lower fourth, which is sometimes practised for a wound of the trunk in the palm of the hand, is a simple operation; and an inspection of Plate viii. will render more intelligible the following remarks.

Drawing back the inner part of the hand so as to stretch and depress the tendon of the flexor carpi ulnaris, make a cut about two inches long in the hollow observable on the surface, and carry it through the integuments and the deep fascia down to the flexor tendon. By bending now the wrist, the tendon will be relaxed, and can be moved aside. Under the muscle, but covered by a deeper layer of fascia, which is to be divided, the vessels and nerve will appear—the nerve being internal and serving as the deep guide to the artery.

When the sheath has been opened, and the artery detached from it and the surrounding veins, the needle carrying the ligature can be passed easily under the vessel.

In tying the vessel for a wound near the wrist two ligatures are to be used, as in the radial artery, because blood may be poured out above and below.

Branches. Named offsets arise near the large joints of the wrist and elbow, and smaller muscular branches leave the trunk at short intervals.

The *posterior recurrent branch*, *g*, is continued beneath the superficial layer of muscles to the space between the inner condyle of the humerus and the olecranon process, where it supplies the joint, and communicates with the inferior profunda and anastomotic branches (Plate iv.).

Near the beginning, a small branch, *anterior ulnar recurrent*, ascends under the pronator teres to join the anastomotic branch.

The *interosseous artery* arises near the preceding, and divides into two, anterior and posterior, for the front and back of the limb. The posterior is seen in Plate xii.

The *anterior interosseous*, *k*, runs on the interosseous membrane between the two deep flexors as far as the pronator quadratus, *P*, where it passes through the membrane to end on the back of the wrist (Plate xii.): as the artery leaves the front of the limb it sends a branch on the interosseous membrane to the fore part of the wrist.

It supplies branches to the deep muscles. Another offset *median*, *n*, ends in the median nerve and the flexor sublimis muscle: sometimes this last branch is large, and is continued with the nerve to join the palmar arch in the hand.

A *metacarpal branch* proceeds along the inner edge of the metacarpal bone of the little finger, on which it ends.

A small *anterior carpal branch* takes origin opposite the lower edge of the pronator quadratus: it joins the corresponding branch of the radial artery.

Some *cutaneous offsets* pass forwards to the integuments at the outer edge of the flexor carpi ulnaris: three of these may be observed in Plate viii.

NERVES OF THE FOREARM.

The median and ulnar nerves supply the muscles on the front of the forearm, whilst the integuments receive nerves mostly from other trunks. The two have a marked difference in position when entering and leaving the forearm: thus above, the median is superficial in front of, and the ulnar is behind the elbow; but below, the median is deeply placed beneath the annular ligament, whilst the ulnar passes over the ligament.

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|--|---|
| 1. Trunk of the median nerve. | 5. Branch of ulnar nerve to flexor digitorum profundus. |
| 2. Anterior interosseous branch. | 6. Cutaneous palmar branch of the ulnar. |
| 3. Ulnar nerve. | 7. Palmar cutaneous nerve of the median. |
| 4. Branches of ulnar nerve to flexor carpi ulnaris muscle. | |

The *median nerve*, 1, courses between the superficial and deep layers of muscles, till about two inches above the wrist where it approaches the surface (Plate viii.). It distributes nerves to all the superficial muscles except the flexor carpi ulnaris, and offsets of its interosseous branch supply the deep muscles.

Muscular offsets may be seen entering the pronator teres, D, the palmaris longus, and flexor carpi radialis, F, and the flexor sublimis, J.

The *anterior interosseous branch*, 2, runs on the front of the interosseous membrane, with the artery of the same name, between or in the fibres of the flexors of the digits, and ends below in the pronator quadratus, P. It supplies the outer half of the flexor digitorum profundus, and the whole of each of the other two deep muscles, viz., flexor pollicis, and pronator quadratus.

The *cutaneous palmar branch*, 7, arises near the wrist: it is described with Plate viii.

The *ulnar nerve*, 3, is directed through the forearm along the flexor carpi ulnaris muscle, in the position of a line from the inner condyle of the humerus to the pisiform bone. Branches are supplied to one muscle and a half.

Articular filaments. Behind the elbow one or two slender twigs are furnished to the joint.

Muscular offsets. One or two nerves, 4, enter the flexor carpi ulnaris; and one, 5, belongs to the inner half of the flexor digitorum profundus.

The *palmar cutaneous branch*, 6, is conveyed along the lower half or third of the ulnar artery to the integuments of the palm of the hand: it sends offsets around the artery, and communicates with the palmar branch of the median nerve at its ending.

DESCRIPTION OF PLATE X.

VIEWS of the two dissections of the palm of the hand, which are needed to lay bare the superficial and deep muscles, vessels, and nerves.

FIGURE I.

In the left-hand Figure the superficial palmar arch of the ulnar artery, with its offsets, also the nerves to the digits, and the tendons of the flexor muscles, are delineated.

In making the dissection the integuments and the deep palmar fascia are first to be removed. The former may be raised by a cut along the centre of the palm, terminated by cross cuts at the wrist and the roots of the fingers; and as the inner flap is raised, the palmaris brevis muscle will be met with in the fat. After the palmar fascia has been denuded, and its arrangement at the fingers examined, it may be cut behind, where it joins the tendon of the palmaris longus, E, and may be thrown forwards.

By taking away the teguments of one finger, say the middle, the sheaths of the flexor tendons will come into view; and after the removal of the sheath, the arrangement of the tendons will be manifest, as in the ring finger.

CENTRAL MUSCLES OF THE PALM.

In the hollow of the hand lie the flexor tendons, with some other muscles. Laterally the muscles of the thumb and little finger form on each side a ball or prominence, to be noticed afterwards; and the group on the inner side is partly covered by the small subcutaneous palmar muscle.

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|---|---|
| A. Palmaris brevis. | N. First dorsal interosseous muscle. |
| B. Abductor pollicis. | O. O. Two outer lumbricales. |
| D. Flexor brevis pollicis (outer head). | R. Tendons of the flexor digitorum sublimis. |
| E. Tendon of palmaris longus. | S. Tendon of flexor carpi ulnaris. |
| G. Adductor minimi digiti. | V. Flexor sublimis tendons in the palm of the hand. |
| H. Adductor pollicis. | W. Tendon of flexor profundus to the ring finger. |
| J. Abductor minimi digiti. | X. Anterior annular ligament. |
| K. K. Pieces of the sheath of the flexor tendons. | |
| L. Part of the palmar fascia. | |

Palmaris brevis, A. This small subcutaneous muscle is unattached to bone. Consisting of fleshy bundles, more or less separate, which are attached to the palmar fascia, L, it is inserted into the skin at the inner border of the hand, extending downwards a varying distance from the pisiform bone. Its insertion is marked by a surface depression.

When the muscle contracts it elevates the skin on the inner side of the hand, and increases slightly the depth of the palmar hollow.

The tendon of the *palmaris longus*, E, enters the hand over the annular ligament: from its outer side an offset is prolonged to the thumb muscles, whilst the main part ends in the palmar fascia.

Tendons of the flexor sublimis digitorum, V. Four in number, they are directed through the palm over the deep flexor; and at the root of each finger one enters the sheath of the digit, K, with a tendon of the deep flexor. Near the front of the metacarpal phalanx it is slit for the passage of the deep flexor tendon, W; and it is inserted by two slips into the sides of the second phalanx, about half way along the bone.

This muscle brings the middle phalanges towards the palm, and bends thus the nearest phalangeal joints—the first stage in the movement of closing the fingers. As the fingers are approximated to the palm, the muscle raises the metacarpal phalanges by means of the digital sheaths binding its tendons to the bones; and it acts finally as a flexor of the wrist-joint.

Tendons of the flexor profundus (Plate ix.), also four in number, cross the palm beneath the superficial flexor, and may be seen projecting slightly on the sides. Entering the digital sheaths, each is transmitted through the accompanying flexor sublimis tendon, as is shown on the ring finger, and passes onwards to be inserted by a single piece into the base of the last phalanx. Small rounded muscles, the lumbricales, are attached to these tendons in the palm (Fig. ii.).

Between each tendon of the deep flexor and the fore part of the middle phalanx is a thin membranous band (opposite W) uniting the two, which is called "ligamentum breve;" and intervening in like manner between each piece of the superficial flexor and the front of the metacarpal phalanx, is another "ligamentum breve," to fix this tendon to the underlying bone.

The deep flexor draws forward the last phalanges, and bends the last phalangeal joints. Still continuing to shorten, it assists the superficial flexor in bending the metacarpo-phalangeal joints in the act of shutting the fingers; and combined with the same muscle, it will flex the wrist when the digits are closed.

In amputating on the living body through the phalangeal articulations, some difficulty is experienced, when the joint is opened at the back, in entering the knife between the ends of the bones, owing to the flexor tendon drawing the distal against the nearer phalanx; and this difficulty is increased in the case of the last joint, in consequence of the smallness of the part to be held preventing sufficient force being employed to overcome the tendon. When the joint is opened at the front the impeding tendon has been previously cut, and the operation can be executed without hindrance to the passage of the knife.

Sheath of the flexor tendons, K. In each finger this reaches from the palm of the hand to the last phalanx. It is constructed on the one side by the bones; and on the other by fibrous bands, which are thinnest opposite the joints: these thinner pieces have been removed in the dissection.

A synovial membrane lines each sheath, projecting into the palm of the hand, where it is closed; and long tapering folds (vincula vasculosa) are continued from it to the tendons: one of

these, connected with the deep flexor, is shown in the opened sheath of the ring finger. In the thumb and the little finger the synovial membrane of the sheath is continued upwards into a large synovial sac which surrounds the tendons of both flexors beneath the annular ligament.

SUPERFICIAL ARTERIES OF THE HAND.

The arrangement of the superficial palmar arch and its offsets, which is described as the usual one, is figured here, but many hands were examined before this condition was found. The arteries to the thumb and the radial side of the fore finger will be described in the explanation of Fig. ii.

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| <p><i>a.</i> Ulnar artery in the forearm.
 <i>b.</i> Radial artery in the forearm.
 <i>c.</i> Superficial palmar arch.
 <i>d.</i> Superficial volar branch.
 <i>f.</i> Four digital branches of the superficial palmar arch.</p> | <p><i>g.</i> Communicating artery from the palmar arch to the radial branch of the index finger.
 <i>h.</i> Communicating branch to the deep arch from the digital artery of the little finger.</p> |
|--|---|

The *ulnar artery*, *a*, enters the hand over the annular ligament, and curving towards the ball of the thumb forms the superficial palmar arch: it supplies branches to the greater number of the digits.

The *superficial palmar arch*—the continuation of the ulnar artery—lies across the hollow of the hand, between the lower border of the annular ligament and the ball of the thumb. With its convexity towards the fingers, it reaches nearly as far forwards as a line, across the palm, from the middle of the fold between the thumb and the fore finger. Diminishing in size, it ends externally by joining branches of the radial, viz., the superficial volar branch, *d*, pretty constantly, and the branch to the radial side of the fore finger (Fig. ii., *d*) occasionally, by means of the small communicating branch, *g*.

At its inner end the arch is covered by the palmaris brevis muscle, *A*, and thence to the ball of the thumb, by the integuments and the palmar fascia; it rests on the tendons of the flexors of the digits, and on the ulnar and median nerves.

Companion veins lie on the sides of the artery. From the concavity of the arch spring small unnamed offsets ; and from the convexity digital arteries proceed.

The *digital arteries*, four in number, and marked each with the letter *f*, supply three digits and a half. In their course to the digits the three outer lie over interosseous spaces, whilst the other is placed along the inner part of the palm ; and at the cleft of the fingers they divide, except the most internal, into two for the contiguous sides of the digits. Coursing along the fingers they are united by a loop behind each phalangeal joint ; and at the end of the finger they terminate in a loop which gives offsets to the tip, as is seen on the fourth digit.

The following communications take place between the digital arteries of the ulnar and the branches of the radial. At the inner side of the palm the branch *h*, which springs from the artery to the inner side of the little finger, joins either the deep arch or an interosseous branch ; at the roots of the fingers the digital arteries anastomose with the interosseous branches of the deep arch ; and at the tip of the fore finger the digital artery on the ulnar side inosculates with the *arteria radialis indicis*.

In the hand the large digital vessels and nerves lie over the intervals between the metacarpal bones ; and in the fingers they occupy the sides. Incisions into the palm of the hand can be made therefore with least injury over the line of the metacarpal bones ; and a cut into a finger, along its centre.

Wounds of arteries in the palm of the hand are followed generally by copious bleeding, in consequence of the numerous communications between the chief vessels. In an injury of the superficial palmar arch, at *e*, for instance, blood will be furnished by the ulnar trunk, *a*. And though this source might be cut off by a ligature, the blood could be supplied by the radial artery to the other end of the arch, through the anastomosing branches, *d*, and *g* ; or through the anastomoses above described of the digital with the interosseous arteries, and with the *arteria radialis indicis*. In such an arrangement of the vessels as that delineated in the Figure, the bleeding from the wound might be commanded by placing a ligature on each side of the orifice in

the artery ; or, as is more commonly done, by stopping the currents in the radial and ulnar trunks by pressure above the wrist, and by applying a graduated compress to the seat of injury. If, when the orifice of the artery has not been secured by a thread, pressure has been found ineffectual in stopping the bleeding, ligature of the ulnar artery, or of this and the radial, would have to be performed in addition to a compress to the wound.

But there is an occasional condition of the vessels, which renders the arrest of the hæmorrhage difficult unless the artery is tied in the wound. For instance, a third artery, sometimes as large as either the radial or the ulnar, may join the middle or the outer part of the superficial palmar arch, so as to bring blood freely to the wound. And as this vessel (usually an offset of the anterior interosseous, but sometimes of the brachial or the radial*) courses with the median nerve beneath the annular ligament, and generally beneath the muscles, pressure would not be productive of much benefit in stopping the current in it, and ligature of it would be scarcely practicable. Recurring bleeding with the existence of this state of the vessels would be quite uncontrollable by means which would arrest it when the ordinary arrangement existed.

As the state of the palmar wound is sometimes unfavourable to any attempt to place a ligature on the vessel there, and as surgeons have a reasonable disinclination to enlarge wounds of the palm to search for the bleeding orifice, ligature of the brachial trunk has been practised when the bleeding resists the usual means of stopping it. The following case, illustrative of the inefficacy of securing the main trunk of the limb at a distance from the wound when a large branch joins the arch directly, as in the condition stated above, is instructive.

“A young man wounded his palmar arch : secondary hæmorrhage took place several times ; the radial and ulnar were tied, but the bleeding returned ; an artery of some size, a ‘*vas aberrans*,’ was discovered beating in the middle of the forearm, close under the

* Examples of these conditions of the arteries, collected chiefly by Mr. Quain, are contained in the museum of University College, London.

skin ; a ligature was put on the brachial in the middle of the arm, with the hope of getting above the origin of the abnormal branch ; it (the unusual branch) continued however to pulsate after the ligature was tightened ; the *vas aberrans* itself was therefore tied at once, close below the elbow, but notwithstanding all these precautions, hæmorrhage occurred on the following day as violent as ever ; the wound (in the palm) was a second time enlarged, and fortunately the blood burst forth at the time of operation and the wounded artery was easily tied : the patient recovered rapidly.”*

The result of ligature of the brachial in the above-cited case teaches, that tying the vessel in the wound of the palm, if such a step is possible, is to be preferred to a distant operation on the main artery of the limb, in those instances in which the surgeon suspects that a large unusual median artery joins the superficial palmar arch.

SUPERFICIAL NERVES OF THE HAND.

The median and ulnar nerves divide in the palm of the hand into large branches, which end on the digits as the nerves of touch. They give branches to the superficial muscles; and the ulnar nerve supplies also the deep muscles by means of a special offset.

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| 1. Trunk of the median nerve. | } | 7. Communicating branch from the median to the ulnar. |
| 2. First digital branch. | | 8. Outer digital branch of the ulnar. |
| 3. Second digital branch. | | 9. Inner digital branch of the ulnar. |
| 4. Third digital branch. | | |
| 5. Fourth digital branch. | | |
| 6. Fifth digital branch. | | 10. Trunk of the ulnar nerve. |

The *median nerve*, 1, is the larger of the two trunks distributed in the hand. Issuing from beneath the annular ligament, it is

* This case is reported by Mr. Cadge, in the part of Morton's Surgical Anatomy which was completed by him (London, 1850, p. 371). The artery named "*vas aberrans*," does not correspond with the arteries commonly so called ; and it was probably the "*median artery*," which sometimes arises from the lower end of the brachial, and joins the palmar arch, as Plate 45 of Mr. Quain's Work on the Surgical Anatomy of the Arteries illustrates.

consumed chiefly in five digital branches, which supply both sides of each of the three outer digits, and the outer side or half of the ring finger. Comparatively few branches are furnished to muscles.

The *digital branches* are continued through the palm of the hand, and along the sides of the digits to the extremity, where they end in a tuft of offsets for the supply of the ball and nail-pulp of the finger. To the skin of the palm and the surface of the digits they give many branches.

Two of them supply lumbrical muscles; thus the third nerve, 4, gives a branch to the most external lumbricalis; and the fourth nerve, 5, to the next following muscle.

Muscular branches. Part of the fleshy ball of the thumb is supplied by the branch, 8; this is distributed to the muscles outside the long flexor tendon, viz., to the abductor pollicis, B, opponens pollicis, C, and the outer head of the short flexor, D.

If the median nerve was cut through close to the annular ligament, sensibility would be destroyed in the palmar surface of the hand and fingers outside a line drawn from the middle of the ring finger to the wrist; and it would be diminished at the dorsal aspect of the three outer digits beyond the metacarpophalangeal joints, where offsets from the digital nerves ramify.

The muscles of the thumb before referred to as supplied by the median, and marked B, C, and D, together with the outer two lumbricales, would be paralysed.

The *ulnar nerve*, 10, divides on the annular ligaments into a superficial or digital, and a deep or muscular part.

From the superficial part two *digital branches*, 8 and 9, are furnished to the little finger (both sides), and to half the ring finger; these have a similar distribution to the digital nerves of the median.

The branch marked 9 sends offsets to the palmaris brevis muscle, and the integuments of the inner part of the hand; and the external of the two, 8, receives a connecting branch, 7, from the median nerve.

Insensibility of the palmar surface of the hand and fingers, inside a line from the ring-finger to the wrist, follows incision of

the trunk of the ulnar nerve; and the power of feeling would be lost at the same time on the back of the two inner fingers which are supplied by the same nerve. Besides the paralysis of the deep muscles attending injury of the nerve, which will be noticed in the description of Fig. ii., the small palmaris muscle, A, will lose its power of contracting.

FIGURE II.

Most of the special muscles of the hand, and the deep palmar arch, with its companion nerve, are represented in the right-hand Figure of the Plate.

This dissection follows the preceding; and to carry it out, the superficial palmar arch and the ulnar and median nerves are to be cut through at the annular ligament, and are to be taken away: then the superficial and deep flexor tendons having been cut at the same spot, are to be thrown forwards to the digits—the lumbrical muscles attached to the deep tendons being cleaned as the superficial tendons are raised.

SPECIAL MUSCLES OF THE HAND.

All the muscles which have both origin and insertion in the hand will be now described, with the exception of the palmaris brevis. They consist of three sets: a thumb group, a little-finger group, and a central group for the other digits.

B. Abductor pollicis.	M. Tendon of the flexor longus pollicis.
C. Opponens pollicis.	N. First dorsal interosseous.
D. Outer head of flexor brevis pollicis.	O. Lumbricales muscles.
F. Inner head of flexor brevis.	P. Interossei of the hand.
H. Adductor pollicis.	R. Tendons of flexor digitorum sublimis.
J. Abductor minimi digiti.	S. Tendon of flexor carpi ulnaris.
K. Flexor brevis minimi digiti.	T. Tendon of flexor carpi radialis.
L. Adductor minimi digiti.	V. Tendons of flexor profundus.

The *thumb muscles*, four in number, consist of an abductor, an adductor, and a flexor, with a special muscle to oppose the thumb to the other digits.

Abductor pollicis, B. This is the most superficial muscle. It arises behind from the annular ligament, and the ridge of the trapezium bone; and is inserted by a tendon into the outside of the base of the first phalanx.

The muscle draws away the thumb from the index finger.

Adductor pollicis, H. The origin of the muscle, which is not always separate from the inner head of the flexor brevis, is fixed to the ridge on the palmar surface of the metacarpal bone of the middle finger; and the muscle is inserted with the inner head, F, of the short flexor into the inner side of the base of the first phalanx.

By its action the thumb is placed on the palm and the fore finger, so as to deepen externally the hollow of the hand.

Opponens pollicis, C. The muscle is partly covered by the abductor, and arises, like it, from the annular ligament and the prominence of the trapezium bone: it is inserted into the metacarpal bone of the thumb along the outer edge.

This muscle can abduct the metacarpal bone, and can then so move it as to allow the ball of the thumb to be turned opposite the ball of each digit, as in the act of picking up a pea with the thumb and each finger.

The *flexor brevis pollicis* is divided into two pieces or heads, D and F, at its insertion into the thumb. Single at its hinder attachment or origin, it is fixed to the annular ligament near the lower edge, to two carpal bones (os trapezoides and os magnum), and to the bases of the two metacarpal bones answering to the two carpals. The fibres, collected into two bundles which are separated by the tendon, M, of the long flexor, are inserted into the sesamoid bones, and the base of the first phalanx—the outer head, D, joining the abductor, and the inner head, F, blending with the adductor pollicis.

This muscle bends the metacarpo-phalangeal joint of the thumb; it draws inwards also the thumb over the palm and approaches it to the other digits.

Little-finger muscles. The group of muscles connected with the little finger contains three, viz., an abductor, an adductor, and a short flexor, as in the thumb; but the flexor is sometimes absent.

Abductor minimi digiti, J., arises behind from the pisiform bone; and is inserted into the base of the first phalanx on the inside, sending an offset to join the extensor tendon.*

It draws the little from the ring finger, and assists in bending the metacarpo-phalangeal joint.

Adductor minimi digiti, vel *opponens*, L, arises posteriorly from the annular ligament, and the hook of the unciform bone; and it is inserted into the inner side of the fifth metacarpal bone.

The fibres shortening as they contract, draw forwards the metacarpal bone, and deepen the hollow of the palm.

Flexor brevis minimi digiti, K, takes origin from the annular ligament and the unciform process, superficial to the preceding muscle; it is inserted with the abductor into the base of the first phalanx.

By its position in the hand this muscle is enabled to act as a flexor of the metacarpo-phalangeal joint.

In the *central group* of the hand are included superficial and deep muscles: the former, or the *lumbricales*, are attached to the deep flexor tendons; and the latter, the *interossei*, lie between the metacarpal bones.

The *lumbrical muscles*, four in number, and marked by the letter O, arise from the tendons of the flexor digitorum profundus, near the wrist. Placed on the radial side of the flexor tendons, each joins, opposite the metacarpo-phalangeal joint, the extensor tendon on the back of the first phalanx. The two external muscles arise each from a single tendon, and the two internal from two tendons for each.

They flex the metacarpo-phalangeal joints by bringing forwards the first phalanges, and assist the special flexors in closing the fingers.

The *interossei muscles* occupy the inter-metacarpal spaces—two being present in each space except the first, in which there is only one: they are divided into two sets, palmar and dorsal.

The *dorsal set*, four in number, are shown in Plate xi. Each

* Lehre von den Muskeln, &c. Von Friedrich Wilhelm Theile. Leipzig, 1841, p. 283.

arises from the two bones bounding the metacarpal space, and is inserted into the base of the metacarpal phalanx, chiefly into the bone, though it joins also the extensor tendon by a fibrous process. The first or most external, which is sometimes called abductor indicis, is the largest : it is marked by N.

These muscles act as abductors of the fore and ring fingers from the middle one; and they can move the last-mentioned digit to each side of a line passing lengthwise through it. The first may adduct the metacarpal bone of the thumb to that of the index finger.

The *palmar set*, only three in number, lie in the three inner spaces; and the middle finger does not receive any of this set. Arising from the metacarpal bone of the finger to which each belongs, they are inserted, like the dorsal, into the nearest phalanx of the fingers; each has but a slight attachment to the bone, blending most with the extensor tendon.*

When acting they bring together the separated fingers, and will draw the fingers, into which they are inserted, viz., the fore, ring, and little, towards the middle digit.

DEEP ARTERIES OF THE HAND.

The radial artery ends in the palm of the hand by forming an arch; and it furnishes arteries to the digit and a half left unsupplied by the ulnar trunk. It enters likewise into numerous communications with offsets of the ulnar artery.

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| <p><i>a.</i> Deep palmar arch.
 <i>b.</i> Profunda branch of the ulnar artery.
 <i>c.</i> Large artery of the thumb.
 <i>d.</i> Digital artery to the radial side of the fore finger.</p> | | <p><i>e</i> Communicating branch to the deep arch from the digital artery to the little finger.
 <i>f, f.</i> Two inner interosseous arteries.
 <i>h, h.</i> Offsets to lumbrical muscles.</p> |
|---|--|--|

Radial artery. Passing into the hand through the first interosseous space, it furnishes digital arteries to the thumb and the fore finger, and ends in the deep palmar arch.

* This difference in the insertion of the dorsal and palmar sets, is stated by Theile in the work on the muscles before quoted, p. 286.

The *digital artery of the thumb*, *c* (art. magna pollicis), courses along the metacarpal bone, and divides into two branches near the joint between that bone and the phalanx: these supply the sides of the thumb, and join at the tip in the usual way.

The *digital artery of the index finger*, *d* (art. radialis indicis), lies along the second metacarpal bone; and issuing from beneath the adductor pollicis, *H*, runs on the radial border of its digit to the extremity, where it anastomoses with the digital artery from the superficial palmar arch. Sometimes it joins the superficial palmar arch through a branch, *g*, Fig. I.

The *deep palmar arch*, *a*, is the curve formed by the end of the radial artery. It reaches from the first to the fourth interosseous space, but placed near the carpus, and is rather convex forwards, like the superficial arch. At the inner end it communicates with the profunda branch, *b*, of the ulnar; and with the branch, *e*, belonging to the digital artery of the inner side of the little finger. The arch has a deep position in the hand;—internally it is covered by the adductor minimi digiti, *L*; externally by the inner head of the flexor brevis pollicis, *F*; and between these, by the flexor tendons: it rests on the three middle metacarpal bones, and their intervening muscles.

Offsets of the arch.—From the concavity small offsets are directed back to the carpus. Three small *perforating arteries* pierce the three inner dorsal interosseous muscles to reach the back of the hand. The chief branches are described below:—

Interosseous branches, *f, f*.—Only two of these now appear, and the third lies beneath the adductor pollicis: they extend to the clefts of the fingers, giving muscular twigs, and end by joining the digital arteries of the superficial arch.

Muscular branches, *h, h*, supply the two or three inner lumbrical muscles.

Through the communication of the radial with the ulnar artery at the inner side of the hand, blood would find its way directly into the superficial palmar arch, after ligature of the ulnar trunk above the wrist; and by means of the anastomoses between the branches of the two arteries (p. 89), the blood would be conveyed from the superficial to the deep arch.

Wounds of the deep arch are rare, in consequence of its deeper and securer position in the hand; and ligature of the vessel would be oftentimes impossible. Supposing the wounded vessel cannot be reached, the bleeding would most commonly be arrested by a graduated compress to the wound, and by pressure on the radial and ulnar arteries in the lower third of the forearm. If those means fail to stop the bursting forth of the blood, ligature of the radial artery—the chief vessel entering the arch—would probably be effectual in commanding the hæmorrhage. Should bleeding still occur, and possibly from large communicating branches with the ulnar artery, for no large unusual artery joins the deep arch, tying the ulnar trunk might be tried. As a last resource ligature of the brachial artery remains.

DEEP NERVE OF THE PALM.

The ulnar nerve is distributed to those muscles of the inner and deep parts of the palm of the hand, which do not receive branches from the median nerve.

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| 1, 1. Branches to the lumbrical muscles. | | 2. Deep palmar branch of the ulnar nerve. |
| | | 3. Trunk of the ulnar nerve. |

The *deep palmar branch*, 2, of the ulnar nerve, arising near the wrist, passes deeply between the flexor brevis and abductor minimi digiti, or through the adductor muscle, L, as in the Figure, and accompanies the radial arch to the first interosseous space, where it ends by supplying the adductor pollicis, H, and the inner head, F, of the flexor brevis pollicis.

Muscular offsets are furnished to the muscles of the little finger, viz., adductor, J, flexor brevis, K, and adductor, L; to all the seven interossei muscles; and to the inner two lumbricales.

All the muscles of the hand, except two and a half of the thumb and the two outer lumbricales, receive branches from the deep part of the ulnar nerve. Destruction of the trunk of the ulnar nerve in the arm would affect the movements of the thumb

and fingers; but notably those of the little and ring fingers, whose short or hand muscles depend solely on the ulnar nerve for their contractile power.

DESCRIPTION OF PLATE XI.

THE dissection of the superficial muscles and vessels on the back of the forearm and hand is here illustrated.

This view was obtained by reflecting the integuments from the elbow to the roots of the fingers; and by removing the deep fascia, with the exception of the posterior annular ligament near the wrist. The fore finger was then denuded of its cutaneous coverings, to trace the extensor tendon to the end.

SUPERFICIAL MUSCLES.

At the back of the forearm are located the muscles which oppose by their action the muscles in front; and as the anterior group consists of flexors and pronators, so the posterior includes their antagonists—extensors and supinators.

The posterior set is divided, like the anterior, into superficial and deep layers. In the superficial layer are contained one supinator, and the extensors of the wrist and digits, which are indicated below by the letters of reference.

A few of the deeper muscles appear near the wrist, but these will be described with Plate xii.

A. Biceps flexor brachii.
 B. Supinator longus.
 C. Extensor carpi radialis longior.
 D. Extensor carpi radialis brevior.
 E. Extensor digitorum communis.
 F. Extensor minimi digiti.
 G. Extensor carpi ulnaris.
 H. Anconeus.

J. Brachialis anticus.
 K. Extensor ossis metacarpi pollicis.
 L. Extensor primi internodii pollicis.
 N. Extensor secundi internodii pollicis.
 O. Dorsal interosseous muscle.

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| <p>P. Fibrous bands joining the extensor tendons near the knuckles.</p> <p>R. Expansion from the extensor tendon opposite the finger joints.</p> | <p>S. Splitting of the extensor tendon.</p> <p>T. Insertion of the extensor tendon into the last phalanx.</p> <p>V. Tendon of the indicator muscle.</p> <p>X. Posterior annular ligament.</p> <p>+ Deep fascia of the arm.</p> |
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The *supinator longus*, B ("brachio-radialis," Sæmmer.), is the most external muscle; it appears also in the anterior view of the forearm, with the description of which (Plate viii.) part of its anatomy has been given.

Arising, as before said, from the upper two thirds of the condyloid ridge of the humerus, and from the intermuscular septum, it is inserted into the radius close to the root of the styloid process.

Narrowed at the origin, it is widened below the elbow over the subjacent muscles forming the prominence on the outer side of the forearm. The anterior border touches the brachialis anticus, J, the biceps, A, and the pronator teres (Plate viii.); and the posterior edge is in contact with the extensor carpi radialis longior, C, and with the extensor carpi radialis brevior,* D. Near its insertion the tendon is covered by the extensors of the thumb.

This supinator acts mostly as a flexor of the elbow joint. If the hand is greatly pronated, the muscle can draw backwards the radius to a small extent; and if the hand is much supinated, the lower end of the radius will be moved somewhat forwards as in pronation: in both cases the hand is brought into a state midway between pronation and supination (Theile).

* This projection backwards of the supinator so as to touch the extensor carpi radialis brevior is not referred to by anatomists of authority. It is not represented by Albinus in his standard work, *Tabulæ Anatomicae Musculorum Hominis*. Lond. 1747; nor in the modern work of Bourgery and Jacob, *Traité complet de l'Anatomie de l'Homme*. Paris, 1833. Neither Theile, in his treatise on the muscles in Semmerring's *Anatomy (Lehre von den Muskeln, &c.* Leipzig, 1841); nor Henle, in his recent *Handbuch der Systematischen Anatomie des Menschen*, Dritte Abtheilung, Braunschweig, 1858, takes notice of the fact. Cruveilhier is silent also respecting this connection of the muscle in his systematic work, *Traité d'Anatomie descriptive*. Deuxième édition. Paris, 1843.

The *extensor carpi radialis longior*, C, arises from the lower third of the outer condyloid ridge of the humerus, and, below the elbow, from the intermuscular septum between it and the following extensor. In the lower part of the forearm its tendon passes through the posterior annular ligament with the shorter extensor, and is inserted into the base of the metacarpal bone of the index finger.

The muscle is superficial above and below ; but it is covered by the supinator longus in the upper part of the forearm.

The *extensor carpi radialis brevior*, D, takes origin from the outer condyle of the humerus by the common tendon,* and from the capsule of the elbow joint. Beyond the annular ligament the tendon is inserted into the base of the metacarpal bone of the second finger.

This extensor is superficial in great part, but two muscles of the thumb, K and L, rest on it below. Along the outer edge lie the long radial extensor of the wrist, and the long supinator.

Both radial extensors draw backwards the hand, extending thus the wrist. The longer muscle can assist the supinator in bending the elbow ; and the shorter one may help in straightening the elbow after the joint has been bent.

Extensor digitorum communis, E. Attached above by the common origin, it ends below in four tendons : these cross the back of the hand, and are inserted into the middle and ungual phalanges of the fingers.

On the hand the little finger tendon is often united in part with that of the ring finger. Near the knuckles all are joined by lateral bands ; but those of the ring-finger tendon being stronger than the rest, prevent extension of that digit whilst the fingers on the sides (little and middle) are bent.

On each finger the tendon forms a common expansion over the first phalanx with the tendons of the lumbricales and interossei.†

* This common tendon is fixed to the lower part of the condyle, and sends downwards aponeurotic septa on the under and lateral surfaces of three other muscles, viz., the extensor digitorum communis, extensor minimi digiti, and extensor carpi ulnaris.

† On the back of the fore and ring-fingers the special extensors of those digits blend with the common expansion.

At the front of the phalanx this expansion divides into three,* S : of these, the central part is fixed into the second phalanx at the base : while the two lateral pieces join, and are inserted as one, T, into the base of the last phalanx. Opposite each phalangeal joint a fibrous expansion is continued from the tendon to the capsule : on the first joint this is indicated by the letter R.

When straightening the fingers the muscle extends the joints from root to tip, separating the digits at the same time ; it acts secondarily as an extensor of the wrist. If the elbow has been bent, it can become an extensor, like the other muscles which take origin by the common tendon.

The *extensor minimi digiti*, F, more or less united with the preceding, is sometimes tendinous in the upper third of the forearm, as is shown in the Plate. Arising by the common attachment, its tendon is divided into two beyond the annular ligament, and the pieces blend on the first phalanx with the other tendons.

The muscle extends the little finger, and exercises afterwards the same action on the wrist joint.

Extensor carpi ulnaris, G. With the common origin above, the muscle is fixed also by aponeurosis to the ulna for three inches below the anconeus, H. Passing through the annular ligament, it has a tendinous insertion into the base of the metacarpal bone of the little finger.

The hand is drawn backwards and to the ulnar side by this muscle.

Anconeus, H. This, the smallest of the superficial muscles, arises from the hinder and lower parts of the condyle of the humerus, and chiefly by a separate tendon. The fibres give rise to a belly of a triangular shape as they are directed downwards and inwards to their insertion into the upper third of the ulna, on the posterior surface. Some of the upper fleshy fibres seem continuous with the fibres of the triceps.

Inserted into the ulna it will draw backwards this bone—the

* In the natural state a thin membrane connects the pieces of the tendon, but this was removed in the dissection to render more evident the arrangement above described.

humerus being fixed—and will extend the elbow-joint in conjunction with the triceps.

Extensors of the thumb. Three muscles, extending the thumb, issue between the common extensor of the fingers, E, and the radial extensors of the wrist, C and D. Two, viz., the extensor of the metacarpal bone, K, and that of the first phalanx, L, lie close together on the outer border of the forearm; and the third, the extensor of the last phalanx, N, is placed below the others, and is separated from them by an interval. The anatomy of these muscles will be found in the description of Plate xii.

Indicator muscle, V. Only below the annular ligament is the tendon of this muscle visible; and it blends with the common expansion on the first phalanx of the fore finger.

The *posterior annular ligament, X*, confines the tendons of the muscles to the wrist, so as to make the extensors of the digits carry backwards the hand after the digits have been straightened. Formed mostly of transverse fibres, but continuous above and below with the special fascia of the limb, it is fixed externally into the radius and internally, where it reaches lower down, into two bones of the carpus—cuneiform and pisiform.

As the tendons pass beneath this band they are lodged in separate channels. There are six spaces, in which the tendons are arranged in the following order:—The most internal compartment contains the extensor carpi ulnaris, G; and the one that follows on the outer side is occupied by the extensor minimi digiti, F. The next space receives the common extensor of the fingers, E, and the special extensor of the fore finger, V; and then comes a narrow sheath for the extensor secundi internodii pollicis, N. Still to the radial side is a large space lodging the two radial extensors of the wrist, C and D; and most external of all is the tube through which pass the extensor ossis metacarpi pollicis, K, and extensor primi internodii pollicis, L. Each sheath in the ligament is provided with a synovial membrane.

All the tendons, with one exception, lie in grooves in the subjacent bones, and to the edges of the grooves processes of the fibrous tissue are attached. The tendon not resting on the bone is that of the extensor minimi digiti, F, which lies between the

radius and ulna. On the radial side of that extensor the tendons groove the radius in the order stated; and on the ulnar side, one muscle (ext. carpi ulnaris) is lodged in a hollow on the ulna.

The *dorsal interosseous muscles*, O, arising from the metacarpal bones bounding each space, are pierced behind by vessels—the external one by the radial trunk, and the others, by the perforating branches from the deep palmar arch. The attachments and the action of these muscles are described with Plate X.

ARTERIES OF THE BACK OF THE HAND.

About the wrist, and on the back of the hand, the arteries are derived from the radial and interosseous vessels, and from the deep palmar arch. Above the wrist only superficial branches of the interosseous vessels appear.

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| <p><i>a.</i> Radial artery.</p> <p><i>b.</i> Posterior carpal branch.</p> <p><i>c.</i> Metacarpal branch.</p> <p><i>d.</i> Dorsal branch of the thumb and the index finger.</p> <p><i>f.</i> Dorsal interosseous arteries.</p> <p><i>g.</i> Branch of the posterior interosseous artery.</p> | <p><i>h.</i> Posterior part of the anterior interosseous artery.</p> <p><i>k.</i> Offset of the recurrent interosseous artery.</p> <p>† † † Cutaneous offsets of the posterior interosseous artery.</p> |
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The *radial artery*, *a*, corresponding with the dorsal artery of the foot in the lower limb, winds over the carpal bones and enters the hand through the first interosseous space. Its connections are the following :—

In addition to the common investments of the limb, with superficial veins and nerves, the three extensors of the thumb are directed over it;—two, viz., extensor of the metacarpal bone, K, and of the first phalanx, L, lie close together, and in a line with the styloid process of the radius; and the other, the extensor of the second phalanx, N, crosses close to the spot where it enters the palm of the hand. Beneath the artery are the carpus and the external lateral ligament of the wrist-joint.

Small veins, and ramifications of the external cutaneous nerve, accompany the artery.

Its branches are inconsiderable in size, but numerous, and are distributed to the back of the hand and some digits.

The place of the radial artery can be easily ascertained through the skin, if the tendons crossing it are made prominent by extension of the thumb; and as the vessel is closer to the extensor of the second phalanx than to the others, this tendon should be taken as the guide to it.

Slight wounds on the back of the wrist would be likely to open the artery; and when the radial lies over the tendons instead of under them, it is still more superficial, and is more exposed to accident.

In disarticulation of the metacarpal bone of the thumb, the artery lies close to the joint, and will be cut unless the knife is kept near the bone.

Branches of the artery supply the carpus, the metacarpus, and the digits.

The *posterior carpal branch, b*, forms an arch behind the wrist with a corresponding branch of the ulnar artery, and communicates with the posterior interosseous, *g*: from this carpal arch interosseous arteries are sometimes given to the inner two metacarpal spaces.

The *metacarpal branch, c*, arising here in common with the preceding, runs to the second interosseous space, and ends at the front of the space in two branches for the contiguous sides of the fore and middle digits on the dorsal surface. Behind it receives a perforating branch from the deep palmar arch, and in front it communicates with the digital arteries.

Dorsal interosseous arteries, f, f, lie over the inner two interosseous muscles, and are derived from the dorsal carpal arch; or they may come from the perforating arteries of the deep palmar arch, as in the dissection from which the Drawing was made. At the cleft of the fingers they give offsets to the sides of the digits, and anastomose with the digital arteries; and if they spring from the dorsal carpal arch, they receive, behind, the perforating arteries from the deep palmar arch.

Dorsal branches of the thumb and fore finger.—Two small branches belong to the thumb, and these run along the meta-

carpal bone—one on each side, to the last phalanx: the inner one of these is marked *d*; and the outer one springs from the radial trunk, about half an inch higher up. There is one branch for the fore finger, which is continued on the radial side of that digit, and supplies the integuments; in this body it is conjoined with the inner artery to the dorsum of the thumb.

Both the posterior interosseous artery, *g*, and the anterior interosseous, *h*, appear near the wrist; but they belong to the deeper dissection, with which they will be described.

DESCRIPTION OF PLATE XII.

THE deep muscles of the back of the forearm and the posterior interosseous artery and nerve are pictured in this Plate.

The superficial muscles have been cut through near their origin, with the exception of the supinator longus on the one side, and the anconeus on the other. In reflecting the extensors of the fingers, the branches of vessels and nerves to them should be defined at the same time.

DEEP MUSCLES.

In the group of deep muscles at the back of the forearm are included three extensors of the thumb, the special extensor of the fore finger, and the short supinator.

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| A. Supinator brevis. | H. Anconeus muscle. |
| B. Extensor ossis metacarpi pollicis. | K. Extensor carpi radialis brevior. |
| C. Extensor primi internodii pollicis. | L. Extensor carpi radialis longior. |
| D. Extensor secundi internodii pollicis. | M. Supinator longus. |
| E. Extensor proprius indicis. | N. Brachialis anticus. |
| F. Extensor longus digitorum, cut. | P. Biceps brachii muscle. |
| G. Extensor carpi ulnaris. | R. Triceps brachii muscle. |
| | S. Posterior annular ligament. |
| | + External lateral ligament of the elbow-joint. |

The *supinator brevis*, A, nearly encircles the upper part of the radius, and is the highest of the deep muscles. It arises from the ulna below the small sigmoid notch, from the orbicular ligament of the radius, and from the external lateral ligament of the elbow-joint. The fibres curve forwards and downwards, and are inserted into the radius so as to cover that bone as low as the pronator teres, except along a triangular surface on the inner side: the lowest fibres taper to a point externally, and the highest enclose the neck of the radius.

The connections of the supinator with muscles, vessels, and nerves, are numerous and complicated. An anterior view of the muscle is given in Plate ix. Perforating the muscular fibres is the posterior interosseous nerve; and the posterior interosseous artery appears at the lower border.

The muscle turns the upper end of the radius backwards, and supinates the hand. It is the direct antagonist with the biceps of the pronator teres; and in consequence of the attachment of both muscles near the upper end of the radius, they keep the upper fragment supinated in fracture of the shaft of the bone.

Extensor ossis metacarpi pollicis, B, the largest of the thumb extensors, arises from both bones of the forearm, and from the interosseous membrane, viz., from three inches of the radius below the supinator, and from a narrowed surface of the ulna of about the same length, and close to the outer edge.

In company with the next extensor it occupies the outer compartment of the annular ligament; and it is inserted into the base of the metacarpal bone of the thumb, and into the os trapezium (Theile).

It moves the thumb out of the hollow of the hand towards the radius, hence the origin of the term abductor which has been given to it. After the thumb is drawn backwards, the muscle will assist in the extension of the radial side of the wrist.

The *extensor primi internodii pollicis*, C, is the smallest of the extensors, and arises from one bone and the interosseous membrane—being attached to the posterior surface of the radius for about an inch, but to rather more of the membrane. After passing through the annular ligament, the muscle is inserted into the

base of the nearest phalanx ; its tendon is united often with that of the extensor of the metacarpal bone.

Its primary action is to extend the nearest joint of the thumb ; and contracting still more, the muscle will extend the wrist-joint.

Extensor secundi internodii pollicis, D, arises, like the preceding, from only one bone and the interosseous membrane, and chiefly from an impression on the ulna about four inches long, which lies inside that for the extensor ossis metacarpi. Contained in a separate space in the annular ligament, the tendon is continued over the back of the wrist, and the radial extensors of that joint, to its insertion into the base of the last phalanx of the thumb.

The muscle will extend the last joint of the thumb ; and it can afterwards assist the other extensors in moving backwards the thumb, and extending the wrist.

Extensor indicis, E. The indicator muscle arises, inside the preceding, from the shaft of the ulnar for three or four inches below the middle (in length), though reaching sometimes as high as the anconeus. Passing through the annular ligament with the common extensor, it is directed to the fore finger, where it joins on the first phalanx the common tendinous expansion (p. 101).

The name expresses its action on the fore finger. If all the fingers are opened together, it assists the common extensor. When the fore finger is straightened, the other digits being closed, this muscle alone points the finger ; for, during the act, the part of the common extensor to that finger is passive, being drawn out of line towards the second finger by the fibrous band connecting the two outer pieces of the extensor tendon.

Supinator longus, M. In this Plate the peculiar shape of the upper part of the muscle, and the way in which it curves over the long extensor of the wrist to touch the short extensor, can be observed.

The *posterior annular ligament*, S, is described with Plate xi. In the dissection the sheath containing the common extensor of the digits was opened to trace the ending of the posterior interosseous nerve on the back of the wrist.

ARTERIES AT THE BACK OF THE FOREARM.

The posterior interosseous artery, and the ending of the anterior interosseous artery and some of its offsets, ramify amongst the muscles on the back of the forearm. Opposite the elbow joint the radial recurrent artery is directed backwards to the superficial muscles.

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| <p><i>a.</i> Posterior interosseous artery.
 <i>b.</i> Recurrent interosseous.
 <i>c.</i> Communicating branch to the anterior interosseous.
 <i>d.</i> Continuation of the posterior interosseous artery.</p> | <p><i>e, e.</i> Perforating offsets of the anterior interosseous.
 <i>f, f.</i> Terminal parts of the anterior interosseous.
 <i>g.</i> Recurrent radial artery.
 <i>h.</i> Trunk of the radial artery.</p> |
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The *posterior interosseous artery* springs from the common interosseous trunk in front of the limb (p. 83, Plate ix.), and bends back above the interosseous membrane. Appearing, behind, between the supinator, A, and extensor ossis metacarpi, B, it is directed between the superficial and deep strata of the muscles as far as the lower third of the forearm ; here it becomes superficial, and courses along the tendon of the extensor carpi ulnaris, G, to the wrist, where it ends in offsets, which communicate with the anterior interosseous, *f*, and with the posterior carpal, *b* (Plate xi.). Its named branches are recurrent and muscular.

Muscular branches supply the deep layer, and the digital and ulnar extensors of the superficial layer ; those to the superficial layer have been cut in detaching the muscles.

The *recurrent branch*, *b*, ascends between the supinator, A, and anconeus, H ; and supplying both muscles, anastomoses with the superior profunda artery. (Plate vii.)

The *anterior interosseous artery*, *f*, comes from the front, through an aperture in the lower part of the interosseous membrane, and ends on the back of the wrist, anastomosing with the posterior carpal and interosseous arteries ; it gives a considerable offset to the outer side of the wrist.

Perforating branches of the anterior interosseous artery, *e, e*, three or four in number, pierce the interosseous membrane, and

anastomose together as well as with the ending of the anterior interosseous, *f*.

Recurrent artery, g, of the radial, ascends beneath the supinator longus, *M*, and communicates with the upper profunda in the arm. (Plate vii.) It supplies the supinator, and the radial extensors of the wrist, also the brachialis anticus; and a considerable offset enters the supinator brevis, *A*, and communicates with the recurrent interosseous.

Radial artery, h. The anatomy of the trunk and branches of this artery on the back of the wrist and hand has been given in the description of Plate xi., to which reference may be made.

NERVE OF THE BACK OF THE FOREARM.

The musculo-spiral nerve supplies the extensor and supinator muscles of the back of the forearm.

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| <ol style="list-style-type: none"> 1. Musculo-spiral trunk. 2. Radial nerve. 3. Posterior interosseous. 4. Branch to the two first extensors of the thumb. | <ol style="list-style-type: none"> 5. Branch to the third extensor of the thumb and the indicator muscle. 6. Continuation of the posterior interosseous nerve. 7. Gangliform enlargement of the nerve on the wrist. |
|--|--|

The trunk of the *musculo-spiral nerve*, 1, has been traced through the triceps to the outer part of the arm. (Plate vii.) Guided afterwards by the long supinator, *M*, and resting on the brachialis, *N*, it reaches the outer condyle of the humerus, and divides into two—radial and posterior interosseous. Branches from it enter the two muscles mentioned, also the long extensor of the wrist, and sometimes the short extensor.

The *radial nerve*, 2, has solely a cutaneous distribution, and ends in the integuments of the back of the hand, and the three outer digits.

The *posterior interosseous nerve*, 3, pierces the supinator brevis, and runs between the two strata of muscles to the middle of the forearm. Then sinking under the extensor of the second phalanx of the thumb, it is continued on the interosseous mem-

brane to the back of the wrist, where it swells into a reddish gangliform body, 7, under the tendons of the common extensor, and gives offsets to the articulations.

All the muscles of the deep layer, and those of the superficial layer, except these three anconeus, long supinator, and long radial extensor of the wrist—receive branches from this nerve.

As the nerve supplies the extensors and supinators of the forearm, injury or disease of it may be attended by paralysis of those muscles ; and as the flexor and pronator muscles in front, supplied by different nerves (median and ulnar), would then be unopposed in their action, they would determine the position of the limb. Consequently, after the function of the nerve is destroyed, the hand would be pronated, the wrist bent, and the fingers semiflexed by the action of the anterior group of muscles on the joints. This state of the limb is seen in the colic of painters.

With the subjoined concise notice of the general arrangement of the muscles, vessels, and nerves of the arm, and of the similarity between the two limbs, the anatomy of the upper limb will be brought to an end.

The upper has its counterpart in the lower limb ; and with the palm of the hand up, the front of the upper limb is represented by the back of the lower ; and the opposite.

The movements of the joints have a close resemblance in the two members ; but the scapula and radius, possessing special movements, are provided with some muscles which are not required in the buttock and the leg.

As all the joints in the upper limb bend forwards, the flexors occupy the anterior, and the extensors the posterior surface ; contrary to their position in the lower limb on the opposite aspects of each segment.

The vessels have a ramified distribution in the limbs—the branches diminishing in size, and increasing in number towards the digits, in the same way as the bones.

The offsets of the artery, unobstructed by valves, join freely

together, and form larger and more frequent anastomoses the nearer they approach the digits; and in this way provision is made for the onward course of the blood even when the trunks may be closed.

The veins are provided with valves, which prevent a backward flow of the blood in them; and they are also united by collateral branches, so that the circulating fluid, stopped in one vessel, may be carried upwards more or less perfectly by another channel. Besides the deep veins, which are more numerous than the arteries they accompany, superficial veins ramify in the subcutaneous fat: both sets join at intervals.

In both limbs the nerves divide and decrease in size, like the arteries; but the branches are very constant, and regular in their distribution: they seldom join each other, unless they are subcutaneous.

All the nerves of the upper limb, with the exception of a few in the integuments of the shoulder and inner side of the arm, come from the brachial plexus. Each of the larger nerves supplies muscles and integuments. The smaller ones end altogether in the muscles about the shoulder. And two (large and small internal cutaneous) belong solely to the teguments.

Three nerves reach the fingers:—of these, one (musculo-spiral) ends on the dorsum; and the other two (median and ulnar) ramifying on the palmar surface of the digits, constitute specially the nerves of touch.

The three large nerves last mentioned supply most of the muscles below the shoulder:—the musculo-spiral being distributed to the extensors and the supinators, and to one flexor in part (brachialis anticus); and the ulnar and median giving branches to the flexors and the pronators.





